A STUDY OF CENTRAL IOWA HIGH SCHOOL SENIORS' COMPUTER LITERACY AND WORD PROCESSNG SKILLS

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by Jill M. Friestad-Tate
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Approved by Committee:

Janet McMahill, Chair

Robert Hoehle

Thomas Westbrook

Salina Shrofel
Dean of the School of Education

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An Abstract of a Dissertation by
Jill M. Friestad-Tate
December 2002
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Advisor: Janet McMahill

The problem: The purpose of this study was to determine the computer literacy and word processing skill level of central Iowa high school seniors. Computer literacy was defined as computer terminology, troubleshooting, and appropriate use of technology, legal and ethical issues in technology, and Internet research and evaluation. Word processing was defined as the ability to create documents using word processing software and incorporate tables and graphs from other applications (TekXam Manual, 2001).

Procedures: The study employed 113 central Iowa high school seniors, randomly selected from a stratified sample of districts by size, during the spring semester of their graduating year. Several questions were asked to determine if differences existed in test scores between students with various levels of access to computers at school and home, gender, and school size. Students and administrators completed demographic sheets to gain insight regarding computer usage and availability. Student demographic variables included gender, computer availability at home, and computer courses taken beyond basic keyboarding. Administrator demographic variables included technology money available for each building and district, student:computer ratio, number of computers in the building with access to the Internet, and the comfort and skill level of teachers with various computer applications.

Findings: The findings included statistically significant results on the General Computing Concepts module for those students who had access to a computer to complete schoolwork and those who did not and the Word Processing module between medium and large and non-public schools. No statistically significant differences were reported in regard to gender, having a computer at home, or taking a computer course beyond basic keyboarding. Seven of 113 students passed the general computing concepts module; while, forty-one of 113 students passed the word processing module.

Conclusions: The findings reject conclusions that central Iowa high school seniors have the necessary computer literacy and word processing skills to pass the TekXam assessment evaluation.

Recommendations: Recommendations for future research include: expanding the study to include a larger sample; conducting a study on the type of technology and connectivity available to the various districts; conducting a study to ask employers if a passing score on the TekXam assessment evaluation would make a difference in hiring an employee; and conducting a study of the comfort and skill level of teachers teaching technology skills.

Dedication

This dissertation is lovingly dedicated to the memory of my parents, Yvonne Gay Friestad and Louis Friestad, Jr. I am able to complete my work because they provided the foundation, love, and support for me to do so. Always my biggest fans, I love and miss them very much and wish to thank them for being my best teachers throughout my life. They are always with me on my journey.

Acknowledgments

Fredrick Douglas once said, "Without struggle, there can be no progress." As with all doctoral students, the journey to completing one's work contains struggles, triumphs, and finally, victory. Throughout the struggle, however, one grows and becomes more confident and knowledgeable as progress is achieved intellectually, personally, and emotionally. For all of those involved in this endeavor, I would like to say thank you. The struggle would have been much more difficult without your support and guidance.

First, I would like to thank my wonderfully supportive and patient committee: Dr. Janet McMahill, Dr. Bob Hoehle, and Dr. Thomas Westbrook. Each member holds an area of specialty that, combined, helped to create a dissertation of which I am very proud. It has been an honor to work with such professionals in education.

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To my dear friends, Dean Frerichs and Jo Vaske, I would like to say a special thank you. Your support and expertise made it easier for me to understand, and finish, my work in a timely manner, and I appreciate your guidance through my challenges.

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Chapter 1

INTRODUCTION

Technology is an ever-pervasive element of society (Herman, 1999; Kurzweil, 1999; Hoffman & Novak, 1998; Milken, 1998; Coley & Goertz, 1990). From email to cell phones, from the Internet to laptops, applications of technology are changing the way we work, live, communicate, invest, and enjoy leisure time. However, recent studies indicate that individuals graduating from high school or college and individuals in the workforce lack computer literacy skills. Computer literacy skills are vital to students, educators, business leaders, and the government because the labor force continues to change rapidly with the presence of technology in our lives. The "nature of technology is evolving and supplanting itself at a speed unprecedented in human history and the implications for education are enormous" (Milken, 1998, p. 1) and it is imperative that individuals keep pace with these changes.

Researchers report that students do not have the skills needed to fill available positions in the workforce (Herman, 1999; Hadley, 1998; and Schiff & Solomon, 1997). The research specifically suggests that (1) students do not have sufficient computer skills for successfully entering the workplace (2) uniform standards have not been created by the majority of public and non-public schools or at state and federal levels (3) businesses are having difficulties hiring technologically skilled employees to fill new or existing positions (4) there is not equal access to technology for all individuals to learn basic computer skills; and (5) the use of technology has become a basic skill that should be taught to everyone.

The following sections focus on students' access to technology, standards and curriculum, and workforce preparation in an attempt to clarify the focus of this study.

Student Accessibility

One factor thought to determine the skill level students possess is accessibility to technology, both at home and in school. In 1996, 40% of all homes in the United States had a computer. Alarmingly, while 82% of high school students from affluent families had access to computers, only 14% of children from poor families and only 4% of those from rural poor families had similar access (Schiff & Solomon, 1997, p. 94).

There are also racial and ethnic differences in personal computer ownership. In 1998, 46.6% of white Americans owned a home computer, compared to 23.2% of African Americans, a gap that increased by nearly seven percentage points since 1994. A white, two-parent household earning less than $35,000 was nearly three times as likely to have Internet access as a comparable black household and nearly four times as likely to have Internet access as Hispanic households. Certain groups thus appear to show consistently lower levels of access to computers in the home, particularly households that are low income; African-American; Hispanic; Native American; less educated and single-female-headed; or located in the south, rural areas, or central cities (National Telecommunications and Information Administration [NTIA], 2000).

Teachers and administrators do not have much control over access to technology in the home but have attempted to provide equal technology access in the schools. As an example, by 1998, 78% of America's students used a computer at school. When broken down by race, 83% of white students used a computer compared to 71% of Hispanic students and 70% of African-American students. Eighty-six percent of students from high-income brackets used computers, while 78% of middle income, and only 68% of low income students, used a computer at school (Wirt, 2000). Despite efforts to provide equal access, researchers report that disparities continue to exist.

Although state and federal governments have provided guidelines, recommendations, and standards, equal access to technology in school has been thwarted by inadequate funding. In 1997, Schiff and Solomon reported that 80% of the states were 20% or less compliant with state and federal standards in regard to funding for hardware, software, training and technical support. The same 80% of schools were 30% or less compliant with goals of five students per computer and Internet access in every classroom. In fact, the student-to-computer ratio had dropped to an average of ten to one, while multimedia computers were at about 23:1 (Schiff & Solomon, 1997). The recommended ratio set forth by the United States Department of Education in 1997 was 5:1 (Coley, Cradler, & Engel, 1997).

While the emphasis on technological skill development increased between 1997-2001, the problem of accessibility continues. In 2001, CORD, Inc. and The Concord Consortium, under the sponsorship of AT&T Foundation, recommended policy considerations and funding for technology in the state of Texas. The report argued that "information technology offers many educational benefits, and yet its use in our public schools is still primitive. Every adult American must be able to use computers at some level…yet access to the tools is still not uniform across the country. As a result, many students are not acquiring the skills they will need in the 21st century" (CORD, 2001, p. 1).

It seems apparent that what seems commonplace to many is foreign to those who can neither afford technology nor have access to it. This can be viewed as the inevitable gap that exists between information "haves" and "have nots", and long term, our nation cannot afford that gap. Effects of the "digital divide" to the American society are expected to be severe according to Beaupre and Brand-Williams (1997), and "the U.S. economy may also be at risk if a significant segment of our society lacks the technological skills to keep American firms competitive" (Hoffman & Novak, 1998, p. 1). Providing equal access to all members of our nation is imperative if we wish to close this gap and continue forward in the next century.

Curriculum and Standards

A related set of factors contributing to students' lack of computer skills is the absence of computer training in school curricula and non-uniform graduation standards. To assure that schools do not encourage racial and socio-economic disparity, technology use and access must be considered in curriculum planning. In a rapidly changing world, one must look to the insight of individuals such as Lowell Milken who said, "Schooling is America's great equalizer and technology has the potential to be schooling's great equalizer" (Milken, 1996, p. 13). "We have it in us to ensure that the potential for success for all young people is because of—not in spite of—their education…because of its rigor and relevance to their real lives. Because of the preparedness and imagination of their teachers. Because of the infinitely rich experience of learning with tools like technology…" (Milken, 1998, p. 25).

In the School Technology Report, researchers provided several alarming statistics about our public school system. One study concluded that "46 percent of all teachers surveyed estimated that less than half of their students have sufficient computer skills and that number increases to 56 percent for teachers in urban areas" (Schiff and Solomon, 1997, p. 9). Computer skills should be considered as basic as reading, writing, and arithmetic, and therefore, K-12 schools should include a computer skills course as a requirement for receiving a high school diploma.

Although standards have not been implemented uniformly across the nation, several states have begun to address this need. For instance as early as 1983, Texas required computer literacy for all seventh and eighth grade students (CORD, 2001). Since 1996, Lake Washington School District (Washington) has integrated technology into the curriculum. All skills in technology ranging from keyboarding to publishing on the Web to presentations are considered routine skills by the seventh grade (Lake Washington School District No. 414, 1996). Finally, beginning with the graduating class of 2000, the state of North Carolina implemented a statewide test of computer skills that students must pass before graduating from high school. Skills required include basic keyboarding, word processing, spreadsheets and databases.

Several other groups have developed standards and benchmarks in order to assure proper skill development including state and federal agencies, Milken Foundation, the Mid-Central Regional Educational Laboratory (McREL), and individual school districts such as the Des Moines Public School District. In 1990, only eight U.S. states required that "high school graduates must have completed course work or demonstrated proficiency in computers; five more included computer science course work in their college preparatory curriculum requirements" (Coley & Goertz, 1990, p. 7). By 1998, 15 states included some form of computer literacy in their graduation requirements. Clearly, several states appear to understand the importance of computer literacy; however, many students still leave school without taking a course in computer literacy.

In addition to educational institutions, various agencies have written standards indicating what they believe all students should possess before graduating from high school. One group is the International Society for Technology in Education. This organization developed the National Educational Technology Standards (NETS) to guide schools in implementing technology in the curriculum. The technology skills listed in NETS for students in kindergarten through twelfth grade are designed to be developmentally appropriate and are provided in Appendix A. However, many schools do not have adequate funding to ensure that all students receive the skills necessary to perform at the recommended levels upon graduation from high school (Hoffman & Novak, 1998, p. 5).

Another group interested in changes in the public school system is the National Commission on Excellence in Education. In their report, A Nation at Risk: The Imperative for Educational Reform, one of the principal recommendations was that "high school students take more courses in the 'New Basics'—English, mathematics, science, social studies, and computer science" (Coley and Goertz, 1990, p. 5). The report acknowledged that the basic skill set needed by individuals to be successful in today's society has changed from 40 years ago including computer literacy.

It is imperative for the nation to create and distribute uniform standards for students graduating from high school. Without a uniform set of standards and required skill levels in technology, several students will graduate without the skills necessary to be successful in the workplace.

Workforce Preparation

In the future, computer skills will be necessary for many types of work. Schiff and Solomon (1997) predicted that by the year 2000, 60% of all jobs in the United States would require some level of computer literacy. Without these skills, disparities in salaries are likely to exist (p. 93). According to the Family Education Network, located at Familyeducation.com, differences in wages for skilled versus unskilled workers are as high as 15% and will continue to create a gap in earnings for individuals as more and more jobs require technological skills. Alexis M. Herman, Secretary of the United States Department of Labor, cited that the "average high-tech job today pays 78 percent more than the private-sector average" (Herman, 1999, p. 65).

The workforce is demanding more from applicants including a higher level of technical skill. Jobs available in the 21st century will be jobs requiring specific levels of technical skills. "In many cases, there is a mismatch between the skills jobs require and those that applicants possess. America does not face a worker shortage, but a skills shortage" (Herman, 1999, p. x). Milken (1998) reported that the skills students need today are significantly different than those from the past (p. 6). This supports the need for examining curriculum so that it includes the skills and knowledge needed in the 21st century.

According to the Skills 2000 study, Iowa is beginning to witness a shortage of skilled workers to replace retiring workers and to fill new positions. Without the ability to provide skilled workers, Iowa will lose new companies and the higher paying jobs they would bring to the state. Results from the study show that employees and applicants do not have the technological skills employers are demanding (Hadley, 1998). Without the necessary skills, businesses will be forced to spend billions of dollars in training and will suffer reduced or delayed productivity in order to help employees develop necessary skills.

Based on the School Technology Policy report, conducted by the Milken Family Foundation (1997), adults also agree that computer literacy is a basic skill students must acquire in order to be successful in the world today (Schiff & Solomon, 1997, p. 5). "From the public's perspective, seventy-two percent ranked workforce preparation as the highest reason to make a major commitment to equipping schools with computers and up-to-date technology" (p. 21). Lemke (1990) concluded, "the public understands that the basic skills students need in the 1990s are very different than the basic skills that were needed in the 1950s through 1980s" (p. 29).

In the words of President Clinton on January 13, 1999, "No country, no matter how rich, can afford to waste its human resources" (Herman, 1999, p. 13). If students do not have the necessary skills to compete in the U.S. or global workforce, the United States' economy will suffer due to a lack of skilled workers and jobs that go unfilled or to foreign organizations and workers. It is important for educators and business leaders to examine what skills need to be taught and how they will be taught in order for students to be successful in the future. Based on the research presented, one of the first steps in bridging the gap between the skills students possess and the skills needed in the workforce is to determine the levels of computer literacy students possess as they graduate from high school. This information will guide groups as they continue to develop standards and curriculum and provide a basis for preparing students for the workforce.

Purpose of the Study

The purpose of this study was to determine if high school seniors in Central Iowa have the computer literacy and word processing skills necessary to meet standards set by the Tek.Xam assessment instrument. The Tek.Xam assessment instrument was developed by educators and business people to measure subjects' abilities to use computers. Scores on the instrument were compared to Tek.Xam's standards to determine if Iowa students had the computer skills deemed important by the workforce and educational institutions.

Significance of the Study

For years, Iowans have been national leaders in efforts that contribute to computer literacy. State technology funds, area educational agencies, technology specialists, the Iowa Communications Network (ICN), and federal grants have been used to promote the use of technology in local school districts (Jerald & Orlofsky, 1999, p. 82). Given the amount of support provided, students should have acquired basic computer literacy and word processing skills to help them be successful in the workforce upon graduation.

This study examined whether or not selected students in Central Iowa could meet minimum computer skills standards deemed important by industry standards. The results provided background information and data regarding the computer skills possessed by central Iowa's graduating from high school.

Hypothesis

H1: Central Iowa high school seniors possess the computer literacy and word processing skills needed to achieve a passing score on the Tek.Xam assessment examination.

Null Hypothesis

HO: Central Iowa high school seniors do not possess the computer literacy and word processing skills needed to achieve a passing score on the Tek.Xam assessment examination.

After defining terms and narrowing the topic to specific computer skills, several additional research questions were addressed:

- Is there a difference in the scores between males and females?
- Is there a difference in scores between those students who have access to a computer at home and those who do not?
- Is there a difference in scores between those students who have a computer available for schoolwork and those who do not have one available?
- Is there a difference in scores between those students who have taken a computer-related course beyond keyboarding and those who have not?
- Is there a difference in scores between students who attend schools of various sizes?

Delimitations and Limitations

Several limitations to the study exist including:

- the focus was delimited to computer literacy and word processing skills and not all technological skills such as database, spreadsheet, web design, presentation, and peripherals
- due to time constraints and compatibility issues, only two modules, not all five modules, of the Tek.Xam assessment evaluation were used
- a small sample size.

Definition of Terms

Computer Literacy—Defining computer terminology, troubleshooting, and appropriate use of technology, legal and ethical issues in technology, and internet research and evaluation (Tek.Xam, 2001).

Word Processing—Creating documents using word processing software and incorporate tables and graphs from another application (Tek.Xam, 2001).

Technology skills—From the SCANS report (1991), selecting equipment and tools, applying technology to specific tasks, and maintaining and troubleshooting technologies (Fulton, 1997, 4).

Information Technology—Consisting of home computers and other devices for accessing information sources, primarily the Internet (Papadakis, 2000, 1).

Computer skills—For this study, computer skills will be limited to various types of software (spreadsheet, database, word processing, graphics), keyboarding skills, and basic PC hardware knowledge.

Information Literacy—Includes but is not limited to finding information in a variety of sources, evaluating information, making critical judgments about its value, reliability, and validity, and using many communication forms to create and distribute information and knowledge (Fulton, 1997, 4).

Technology Education—Specific technologically related courses taken at the high school level including computer courses and industrial technology courses

Educational Technology—The most current technologies used to teach students in a classroom (overhead, VCR, television, computers, scanners, etc.)

Area Educational Agency (AEA)—An educational agency designed to support school districts in central Iowa through assessment, training, and evaluation.

Chapter 2

REVIEW OF THE LITERATURE

The purpose of this study was to determine if Central Iowa students had the computer literacy and word processing skills necessary to achieve a passing score on the Tek.Xam assessment evaluation. In order to understand the need to examine computer skills in students, a discussion of recent effects and speed of changes in relation to technology, governmental initiatives related to technology, business and labor's difficulties with technology, and educational initiatives need to be addressed. This chapter is divided into sections addressing each of the above-mentioned issues.

Recent Effects and Speed of Changes in Relation to Technology

There are many views about the existence and implementation of technology in American schools. It is important to discover what researchers say about technology, its usefulness and its importance in the workplace. Governmental leaders, as well as business and educational leaders, understand the importance of technology in the schools but can not agree on what should be taught and how it should be taught (Herman, 1999; Milken, 1998; Schiff & Solomon, 1997). The following discussion examines how technology has influenced our present day world and the various facets of technology and will lead into the discussion of technology in relation to education, business, and government technology initiatives.

"Information and communications technology has moved stealth-like into virtually every aspect of our lives, driving the way we create wealth; conduct commerce; cure, protect and entertain ourselves; and communicate with and influence others…it is transforming the way we live, work, learn and view the world" (Milken, 1998, p. 2).

From 1994 to 1998, the Internet impacted over 50 million Americans. It took the radio 38 years to attain the same level of usage (p. 2). Traffic on the Internet doubled every 100 days, and penetrated 25% of the market in just 7 years (p. 8). In 1998, one out of every two employees used a computer at work and businesses increased capital equipment spending on information technology from 7% in 1970 to almost 50%in 1998. The growth in computer sales was four times the pace of the overall economy (p. 9). Businesses demanded that workers "understand and use technology…all skills that should be acquired in school" (p. 10).

The Internet, cyberspace, nanotechnology, AOL, Microsoft, smell-o-vision, and cybersex are all ideas commonly spoken in the digital world but understood by only a handful of individuals outside of that realm (Time, 2000, pp. 60-116). Five years ago, the average person in the United States didn't have a computer in their home or understand how to use the Internet. In 1997, there were over 80 million people in the United States using the Internet while 46% of U.S. households had at least one computer in the home (Schiff & Solomon, 1997, p. 33). In 2000, 54% of U.S. households had a computer in the home and 32% had access to an online service at home (National Science Foundation, 2000).

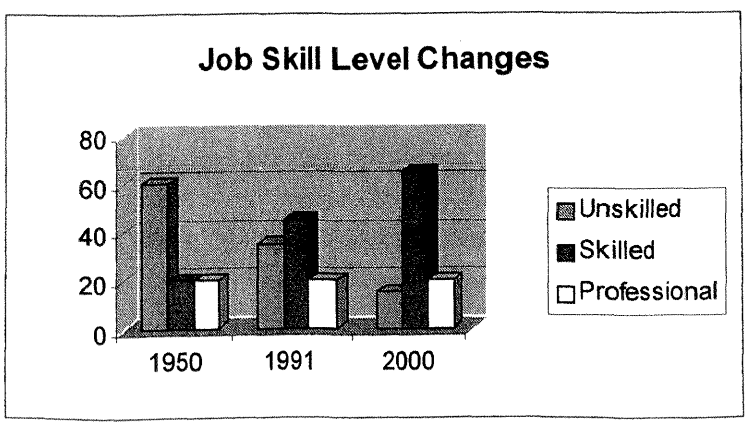
"This is the second great economic transformation in this century. The first was the shift from the agriculture to manufacturing before World War I. The rise of technology has effected a transformation, not only because it required new skills immediately but also because those skills themselves will soon need updating or transforming. By the year 2000, one-third or more of the work force will fit into this category" (Milken, 1996, p. 18).

Because of computer technology, almost everything we have learned in the past has been altered in some way or most likely will be in the future. Human knowledge of the sciences has "increased more in the last decade than in all of human history" (Kaku, 1997, p. 4). By the year 2019, "most adult workers [will] spend the majority of their time acquiring new skills and knowledge" and by 2029, education will "constitute the primary focus of the human species" (Kurzweil, 1999, p. 20). If we don't teach individuals how to think and value learning through experiences and through their own self-motivation, we have failed to prepare them for the future.

According to the National Academy of Sciences, "To be prepared for today's workforce, informed about important issues, and able to understand the complex world in which we live, all Americans must have a solid education in science, mathematics, and technology" (International Technology Education Association, 1999, p. 1).

The skills required of employees have changed in the past 40 years. According to the Bureau of Labor Statistics, in 1950, 60% of all jobs were unskilled. As depicted in Table 1, that number has dropped to 15% in the year 2000. Many unskilled individuals who previously could find decent employment are having difficulties finding work in the new information age. Not only have the skills needed for jobs changed but the jobs available have changed as well. Consider the following information.

Table 1: Bureau of Labor Statistics job skill level changes from 1951-2000.



When parents were asked what is different for students in school today versus the past, 36% said the presence and knowledge of computers, and 17% said technologies (Schiff & Solomon, 1997, p. 5). Technology and computer knowledge is a concern for many parents, as well as employers who must find skilled workers to fill new positions or replace retirees.

"Twenty-five years ago, people who were laid off found jobs that paid as well as their old ones. Today, the Labor Department numbers show that fewer than 30% of displaced full-time workers end up in equal remunerative or better-paid jobs. The numbers are almost equal from blue collar occupations, sales, clerical and service occupations, and from managerial, professional and technical occupations" (Milken, 1996, p. 19). With 80% of the world's wealth now being digital (Schiff & Solomon, 1997, p. 72), combined with an increased number of students and the rapid pace of change involved with technology, it seems foolish not to incorporate technology as part of our educational requirements in the public school system.

Technology Initiatives from the Government

As educational institutions completed research relating to computer usage and accessibility, the United States Federal government also began to focus on the need to examine technology and its effect on the economy. On April 18, 1991, former President George Bush announced a new education strategy called America 2000. Bush encouraged Americans to "think about every problem, every challenge, we face. The solution to each starts with education. For the sake of the future of our children and the nation, we must transform America's schools. The days of the status quo are over" (SCANS, 1991, p. 3).

In June 1991, the Secretary's Commission on Achieving Necessary Skills (SCANS) report was released and "examined the demands of the workplace and whether our country's young people are capable of meeting these demands." The report "determined the level of skills required to enter employment," discussed "fundamental changes in the nature of work", and discussed implications for the "kinds of workers and workplaces the nation must create" (SCANS, 1991, p. 3).

The SCANS report defines two areas required for effective job performance: workplace competencies and foundation skills. "They showed that work involved a complex interplay among five competencies (resources, interpersonal, information, systems, and technology) and three elements of the foundation (basic skills, thinking skills, and personal qualities)" (Department of Labor, 1991, p. 1). Findings of the report showed that "more than half our young people leave school without the knowledge or foundation required to find and hold a good job" (SCANS, 1991, p. 1). They also commented on the two conditions that took place in the last part of the 20th century that changed entry into the world of work: "the globalization of commerce and industry and the explosive growth of technology on the job" (p. 1). The SCANS authors concluded that "these developments have barely been reflected in how we prepare young people for work or in how many of our workplaces are organized" (p. 1). Three conclusions were reached:

1. all U.S. high school students must develop the competencies and foundation skills;
2. the high performance qualities of the most competitive companies must become the standard for most companies; and

3. the nation's schools must become high performance organizations (DOL, 1991, p. 1).

One of the commonly agreed upon workplace competencies is technology. The SCANS report (1991) states, "technology is everywhere, demanding high levels of competence in selecting and using appropriate technology, visualizing operations, using technology to monitor tasks, and maintaining and troubleshooting complex equipment" (SCANS, 1991, p. 6). Competencies included in knowing how to use technology include:

- selecting technology
- judging which set of procedures, tools, or machines, including computers and their programs, will produce the desired results
- applies technology to task
- understands the overall intent and the proper procedures for setting up and operating machines, including computers and their programming systems
- maintains and troubleshoots technology
- prevents, identifies, or solves problems in machines, computers, and other technologies (p. 7).

Several years later, in his 1996 address to the nation, President Bill Clinton called for "connecting every classroom in American to the information superhighway with computers and good software and well-trained teachers" (Coley, Cradler, & Engel, 1997, p. 10). Four educational technology goals were announced and include:

1. All teachers in the nation will have the training and support they need to help students learn using computers and the information superhighway.

2. All teachers and students will have modern multimedia computers in their classrooms.
3. Every classroom will be connected to the information superhighway.
4. Effective software and on-line learning resources will be an integral part of every school's curriculum (p. 10).

Other White House Technology initiatives included America's Technology Literacy Challenge, a five-year effort to help states achieve the set goals. In 1998, $425 million was requested as the second installment of a five-year, $2 billion investment to modernize schools to prepare students for work in the coming century" (Coley, et al., 1997, p. 10).

To support the need for technology initiatives, the United States Bureau of Labor Statistics listed the ten industries with the fastest wage and salary employment growth between 1998 and 2008. The number one, fastest growing industry was computer and data processing services with a 117% increase in the number of jobs needed by 2008 (Bureau of Labor Statistics, 1999). Of the top 10 fastest growing occupations, computer related occupations accounted for the top five including: computer engineers, computer support specialists, systems analysts, database administrators, and desktop publishing specialists.

New occupational listings created by "changes in technology, society, markets or regulations" were also included in the Bureau's list and several technologically related occupations such as web master, computer manager, and desktop publishing specialist were added to the listings for the first time in history. Computer support specialists were listed as the occupation with the largest job growth between 1998-2008 at 102% growth (BLS, 1999).

The government has recognized the growth of technology in the United States and the need to incorporate it as part of our every day lives. Since 1991, the government has actively been involved in analyzing changes in technology, listing initiatives for schools and businesses, and modifying occupational titles in the labor department to adapt to the technological changes.

The number of new occupations and available positions is a positive sign for the country but not enough individuals are equipped with the necessary skills to fill the positions (Herman, 1999; Hadley, 1998). This has created a problem for individuals who desire higher paying jobs and for the employers who cannot find individuals to fill the positions that are available. This problem has left many businesses struggling to find answers to questions about how to build and maintain skilled employees.

Factors Relating to Business and Labor

Although computer numbers and usage are growing at a rapid rate, businesses are not seeing the transfer of useful computer skills in present or future employees (Herman, 1999; Hadley, 1998). Businesses are spending billions of dollars annually to equip employees with needed skills--basic, new, or technological. This costs businesses in monetary terms and also lost work and productivity in taking the time to train or re-train their employees. Due to the enormous cost in training and loss of productivity, businesses want their voice to be heard in determining the direction of schools and the curriculum being taught in them.

Lester Thurow, Massachusetts Institute of Technology economist, estimates that "only 20% of adult Americans have the work skills or education to be competitive in the global market" (Milken, 1996, p. 7). He describes a situation where "NYNEX had to test 60,000 applicants to fill 3,000 jobs" (p. 7). Technology tools "should be commonplace in the life of every school, teacher and student; however, while 75% of all Fortune 500 companies are completely networked, only 3% of instructional rooms are connected" in the public school system (p. 12).

With the change in job titles and rapid growth in technology, many questions remain unanswered for businesses: "How do we ensure that workers get the skills they need to succeed in the twenty-first century? Will employers hire and train workers who initially lack skills? How do we ensure that those with lower educational levels are not left behind by the digital economy? Will businesses invest in workers who have been left behind to ensure the nation's continued prosperity? Will we bring down the barriers to success for all Americans?" (Herman, 1999, p. 10)

These and many other questions have driven the corporate world to increase the number of training institutions. Presently there are more than 1,600 training institutions and these "corporate universities" could surpass the number of traditional universities by the year 2010 (Herman, 1999, p. xvii).

The implications for the business world are tremendous. "In five years, almost half of all workers will be employed in industries that produce or are intensive users of information technology" (Herman, 1999, p. xvii). Without a skilled workforce available in the United States, businesses and government will look outside of the country for competent workers. The labor force will change with the influx of immigrants to this country in the next decade (Fullerton, 1999, Herman, 1999). "By 2050, we expect immigration to increase the United States' population by 80 million" (Herman, 1999, p. 2).

Immigrants will account for population growth of 820,000 people each year, two-thirds of the total United State's population increase. This influx, not birthrate, will account for the majority of America's population increase in the next several years. Two of three immigrants coming to the United States are of working age already but lack technological knowledge and skills to provide high levels of income for their families (Herman, 1999, p. 2). "Even with improvements in the late 1990's, workers who lack the required education and skills will continue to face declining job opportunities and wages" (p. 19). This will present many challenges to educators as well as businesses as individuals look for employment with few skills.

The level of skill immigrants or high school graduates possess will make a sizable difference in the earning power of that individual. "Twenty years ago, the average college graduate earned 38 percent more than the average high-school graduate. Today, it is 71 percent more." (Herman, 1999, p. 18). "The three fastest growing occupations, which are all computer-related, require at least a bachelor's degree" (p. 20).

Almost 76% of students from the top quarter (socio-economically) earn bachelor's degrees—up from 31% in 1980 but, less than 4% of those from low income families now finish college versus 6% in 1980 (Business Week, 1994, pp. 78-83). The difference in wages for individuals with technical skills and education and those without is substantial. Table 2 lists the unemployment rate and yearly earnings for full-time workers age 25 and over by educational attainment.

Table 2: Source: Unemployment rate, Bureau of Labor Statistics, unpublished data; earnings, Bureau of the Census, unpublished data

Unemployment rate in 1998 (Percent)	**Education attained**	**Median earnings in 1997 (dollars)**
1.3	Professional degree	72,700
1.4	Doctorate	62,400
1.6	Master's degree	50,000
1.9	Bachelor's degree	40,100
2.5	Associate degree	31,700
3.2	Some college, no degree	30,400
4.0	High-school graduate	26,000
7.1	Less than a high-school diploma	19,700

By the year 2005, high school graduates can expect to change jobs 12-15 times in their lives (Cattaraugus-Allegarry-Erie-Wyoming BOCES) and will have changed jobs nine times by the age of 32 (Herman, 1999, p. xvii). That being the case, it is vital that individuals have the necessary skills to move from one position to another. "A society divided between the haves and the have-nots or between the well-educated and the poorly educated…cannot be prosperous or stable" warned Labor Secretary Robert B. Reich (p. 79).

"In nearly every industry, the spread of new technologies is creating a need for employees who know how to do more" (Herman, 1999, p. 78). "A great skill shortage is going to occur that will eat away at our competitiveness" (p. 78) worries John L. Clendenin, chief executive of BellSouth Corp. Business has been called to, in the words of President Clinton on January 28, 1999, "create a situation in America where people can keep on learning for a lifetime, without regard to where they live, what their job is, what their income is" (p. 94).

In addition to the national view on career changes, there are state views to be considered. In Iowa, five of the top ten fastest growing occupations relate directly to technology including systems analysts (ranked 1), electronic pagination system workers (ranked 2), computer engineers (ranked 3), database administrators (ranked 4) and computer support specialists (ranked 9) (Iowa Workforce Development, 2000, p. 1). "Between 1996 and 2006, Iowa's economy is expected to generate more than 56,700 job openings annually. Thirty-five percent of these openings will be new jobs." (p. 2). The growth in new jobs is positive for Iowa until it is compared to the lack of qualified applicants discussed earlier in the Skills 2000 and Skillforce 2005 report findings.

With all of the growth in technology and the need for skilled workers in computer-related fields, Iowa should be preparing a workforce that can fill available positions. However, the Cyberstates 4.0 report lists Iowa as 27th in high-tech employment and 45th in the average wage for high-tech workers (Yepsen, 2001, p. 16A). Iowa needs to become aware of and prepare for the changing technological world and the impact it will have on the state.

For the year 2000, Iowa ranked 35th in the United States in Home Internet Access, had only 10% of exports related to technology, had 3.7% of the workforce in high-tech positions (compared to 5% nationally), and ranked 41st in venture-capital investments according to the Cyberstates 4.0 report released by the American Electronics Association. The report also included information regarding annual salaries of high-tech employees. According to the report, the national average earning for high-tech positions is $64,900, while in Iowa, the average wage is $40,307 (Yepsen, 2001, p. 16A). As an educational leader in the country, it is important to determine the level of computer skill students in the state possess.

Factors that influence today's definitions of necessary skills for technological fluency include: demands driven by expanding information and communication resources, business influences, national leadership, and the curriculum standards movement (Fulton, 1997, p. 3). Iowa is not exempt from experiencing the problems that a new and changing labor market brings. Iowa businesses are seeing the effects of the lowest unemployment rate in history combined with a lack of skilled workers.

According to Teree Caldwell-Johnson, Polk County Manager and Chair of the Skillforce 2005 Task Force, "Iowa's unemployment rate has remained below three percent and the number of available jobs in our economy has grown at double the rate of population growth" (Caldwell-Johnson, 2000, p. 2). Both studies cited the lack of skilled workers in Iowa to fill replacement and new positions in our state. The purpose of the studies was to (1) determine new and replacement worker needs to the year 2005, (2) determine the desired and anticipated skills profiles, and (3) determine what jobs have the greatest need for skilled workers (p. 3).

Findings from the Skills 2000 and Skillsforce 2005 studies in Iowa indicate a "trend in the use of technology in every aspect of employment" (Caldwell-Johnson, 2000, p. 5). Technological skills are listed as part of the desired skills by area businesses, specifically those skills relating to word processing, spreadsheet, database, and email functions, ability to use equipment and/or software designed for a specific occupation, and the Internet or Intranet (p. 7).

Many businesses have proposed solutions to meet current challenges in hiring employees. Part of the solution is to get funding and hardware into the schools. In fact, businesses have "contributed about 6-10% of what's been spent so far on technology in the schools" in an effort to improve the knowledge and preparedness of students (Schiff and Solomon, 1997, p. 59). With this contribution, businesses hope to make their needs known and understood in hopes of getting and maintaining productive, trained workers.

In 1995, the Iowa Association of Business and Industry, in cooperation with the Iowa School-To-Work Office, surveyed Iowa's top three percent (fastest) growth industries to determine necessary workplace skills. The results of the survey were tallied and the "13 essential skills" students need "in order to enter and succeed in a changing workplace" were reported. The entire list of essential skills is included in Table 3 and includes being able to use technology, although it does not specify what type of technology is recommended or how it should be used (Iowa Workforce Development, 2000, p. 3). Items included in the technology skill set are based on the competencies developed in the SCANS report (1991) such as "selecting equipment and tools, applying technology to specific tasks, and maintaining and troubleshooting technologies" (p. 2).

Table 3: Thirteen Necessary Skills—Iowa's Tier One Skills

All students should know and be able to:
▪ Communicate and understand ideas and information (listening and writing)
▪ Collect, analyze, and organize information
▪ Identify and solve problems
▪ Understand and work with complex systems
▪ Apply mathematical reasoning to work-related problems
▪ Use technology
▪ Initiate and complete entire activity
▪ Act professionally
▪ Interact with others
▪ Learn and teach on an on-going basis
▪ Take responsibility for career and life choices
▪ Read and understand work-related materials
▪ Participate in teamwork

From the many organizations and commissions who have studied the American workforce, "three themes shape goals for the future: How do we ensure that workers have the skills that provide lifelong economic security?; How do we accommodate workers' needs to balance their jobs with caring for their families?; and How do we ensure that all workers have opportunities in America's workforce and that our diverse population works in safe and fair workplaces?" (Herman, 1999, p. 99).

Business and industry leaders recognize that computer skills and technological advancements have changed the workplace, and they want employees to come to the job market prepared with the necessary skills to work in such an environment. This opens the door for education to step in and prepare individuals for a new and changing workplace. The responsibility to educate young people, as well as adults, falls to educational institutions. The question is, are they ready?

Educational Initiatives and Reform

Since 1880, practically nothing has changed in American classroom practice (Milken, 1998, p. 12). Large group instruction, teacher-as-authority, and limited exposure to technology are all believed to contribute to the fact that "nearly one-third of all entering college freshmen require some type of remedial education" (p. 14). In this rapidly changing world, education should consider changes to its curriculum offerings. The United States should "consider the irony that education, the original knowledge industry, is the last to invest in technology to increase its access to knowledge" (Milken, 1998, p. 22). Individuals "must call for policy makers to make learning technology a top state priority" (p. 24).

With the surge in computer use in society and encouragement by business and government, it would seem logical to include computer skills and technological literacy as part of basic skills instruction in the public school system; however, in 1996, only eight states required technology as a graduation requirement (Coley & Goertz, 1990, p. 5). Data collected in 1998 showed that the number had increased to 15 states requiring technology as a graduation requirement; however, 3 states required more technology for college-bound students than those entering the workforce following graduation (Education Commission of the States, 1999).

State departments of public instruction are not the only organizations looking to improve education. On February 17, 1998, 31 business, educational, and governmental leaders convened at historic Mount Vernon, home of the first U.S. president, to identify characteristics of "schools and systems capable of preparing students for a global knowledge/information age" for the purpose of "helping in discussions and actions taken to reshape schools" (American Association of School Administrators [AASA], 1999, pp. 3,6). Iowa was represented on the Council of 21 by Dr. Les Omotani, superintendent for the West Des Moines Community School District in West Des Moines, IA.

At the closing of the one-day meeting, 200 characteristics were identified using a "weighted formula considering suggested priority and potential impact of each characteristic" (AASA, 1999, p. 3). The 200 characteristics were narrowed to 16 drivers, or themes, with the technology drivers listed in Table 4.

Table 4: Technology Drivers of Schools and School Systems of the 21st Century

1.	The definitions of "school", "teacher", and "learner" are reshaped by the digital world.
2.	Teachers and administrators are effectively prepared for the global knowledge/information age.
3.	Students, schools, school systems, and communities are connected around-the-clock with each other and with the world through information-rich, interactive technology.

Three of the 16 drivers related directly to technology. "As we move into a new era, our economic opportunities and perhaps our survival as a nation will depend on our ability to take a lead in the development and effective use of technology. Schools must play a central role in meeting this challenge" (AASA, 1999, p. 17). According to the Council of 21, technological characteristics of a school in the 21st century would include the following: technology used as an integral learning tool, all classrooms connected to electric networks, all teachers and students provided equal access to technology, technology used to create greater efficiency and effectiveness in learning, technology used to enhance planning, broaden knowledge, self-directed learning, distance learning, and the overall nature of learning, and minimum requirements for teacher re-certification to include technology (p. 16). Further recommendations suggest that "all students access a computer for two hours a day, 365 days a year to work on computer curriculum packages and each student have a laptop computer" (p. 22).

The curriculum, the Council of 21 determined, "must include knowledge, skills, and behaviors that reflect our ever-changing society" (AASA, 1999, p. 23). Schools must "incorporate technology for students" so that "no student should ever be disadvantaged by what the school does or does not do" and so "low income students have as many advantages *in school* as wealthy" (p. 38).

Another suggestion made by the American Association of Secondary Administrators included continuous updating of technology (AASA, 1999, p. 54). The need for a commitment to updating resulted from findings that computer power had doubled 34 times since World War II and a computer that costs $2000.00 today would have cost $16 million a decade ago (p. 55). Seventy-five percent of American schools were built prior to 1970 and weren't designed to support the wiring needed with present-day technology (p. 57). "Our classrooms should be at least as well equipped as our students' living rooms" (p. 58). The needs of several constituencies surfaced during the conference, but the one idea that remained at the forefront was the fact that technology has changed the ways in which we live, learn, and work.

In 1991, the SCANS commission produced a report, *What Work Requires of Schools*, which "describes the knowledge and skills necessary for success in the workplace" (p. 2). With the release of this report, the push for standards and benchmarks became increasingly important to educators and policy-makers and the need to provide equal access for all students became apparent.

"Equal opportunity is about having in the classroom up-to-date computers, Internet connections, powerful content, teachers who are technologically fluent, and technical support. Many students experience a 'double divide' since they also access technology at home and at school. Fourteen percent of students from poor households have access to computers, compared to 82 percent from more advantaged homes" (Milken, 1998, p. 15). In order to ensure equal opportunity, all parties involved must work together.

Several individuals from the business world, government, and education believe computer literacy skills should be considered and taught as a basic skill along with reading, writing, and arithmetic (Schiff & Solomon, 1999; Herman, 1999; Milken, 1998; Fulton, 1997; and Kaku, 1997). Specific course or skills required of students as they transition into the world of work are not agreed upon nationwide. Some individuals feel technology should be integrated across the curriculum, others feel specific job related skills ought to be taught, while still others want educational technology, some want technology to be an elective course only and others wish technology would not be taught at all.

Mid-continent Regional Educational Laboratory (McREL), Secretary's Commission on Achieving Necessary Skills (SCANS), National Business Education Association (NBEA), and Iowa Technology Educational Association (ITEA) are just a few of the organizations and reports researching the skills employers desire of employees in the workplace. Standards and benchmarks have been determined, studies funded and researched, and recommendations to schools given. The challenge lies in discovering funding to support the programs and changes needed to implement the standards in all schools. The federal government of the United States looks seriously at the viability of the standards and the impact it will have on the economy. Currently, research completed by the Bureau of Labor Statistics, the Department of Labor and other agencies are proving the need for government involvement in the issue of educating and preparing students for a changing world.

In an effort to involve business in the educational process, the National Educational Technology Standards (NETS) were created. The primary goal of the NETS project is "to enable stakeholders in PreK-12 education to develop national standards for the educational uses of technology that will facilitate school improvement in the United States" (ISTE, 1998, p. 3). "Standards should be mastered by students in order to provide a framework for linking performance indicators found within the Profiles for Technology Literate Students (listed as Appendix A) to the standards" (p. 5). The mission is to make sure "all students have the opportunity to develop technology skills that support learning, personal productivity, decision-making, and daily life" as well as "preparing students to be lifelong learners who make informed decisions about the role of technology in their lives" (p. 7). Several stakeholders participated in the process of creating the standards and performance indicators as a way to identify a complete set of skills students should possess.

"The standards and performance indicators are based on input and feedback from educational technology experts as well as parents, teachers, and curriculum experts. In addition, they reflect information collected from the professional literature and local, state, and national documents" (p. 7). All standards, profiles, and performance indicators for PreK-12 grades are listed in Appendix A. If the NETS standards were implemented, the skills identified and tested in the North Carolina Test of Computer Skills would be mastered after completing eighth grade.

Nationally, the Mid-continent Regional Educational Laboratory (McREL) has played an instrumental role in determining standards and benchmarks for all curriculum areas based on surveys of businesses and organizations across the United States. McREL began "the systematic collection, review and analysis of national and state curriculum documents in all subject areas" in the fall of 1990 (McREL, 1997, p. 2). In the same year, the Secretary's Commission on Achieving Necessary Skills (SCANS) is appointed to "determine the skills young people need to succeed in the world of work".

Researchers at McREL continued its effort to determine which standards and benchmarks should be taught in American schools. Throughout the next five years, analysis of 116 documents helped the laboratory determine 16 areas for American educators to include in the curriculum. The principle reasons for developing standards are to "clarify and raise expectations and to provide a common set of expectations" for all students in the United States.

Organizations, such as McREL, continually update and develop new standards for education in order to improve effectiveness and efficiency. Former Assistant Secretary of Education, Diane Ravitch, in her book, *National Standards in American Education: A Citizens Guide* (1995), wrote:

> Americans...expect strict standards to govern construction of buildings, bridges, highways, and tunnels; shoddy work would put lives at risk. They expect stringent standards to protect their drinking water, the food they eat, and the air they breathe...Standards are created because they improve the activity of life (pp. 8-9).

McREL researchers continued work to improve standards included five technology standards for the first time in 1996. For the "two standards that address the computer skills students should acquire, two documents from state departments of education served as reference documents, the *Teacher Handbook Component: Computer Skills* (1992) from North Carolina, and the *Texas Essential Knowledge and Skills for Technology Applications* (draft, 1996)" (McREL, 1997, p. 1). The two computer skill standards apply specifically to this study and will be used as a guide in selecting the instrument. "Knowing the characteristics and uses of computer hardware and operating systems" and "knows the characteristics and uses of computer software programs" are divided into grade level benchmarks and listed in Appendix B.

According to the McREL standards, high school students should have mastered computer skills such as "knowing advances in computers and peripherals, using a variety of input devices, knowing limitations and trade-offs various types of hardware, identifying malfunctions and problems in hardware, knowing current features and uses of current and emerging technology related to computing, using listservs, usenets, and bulletin boards, importing and exporting data in different formats and between software programs, knowing advanced features of software (macros, templates, mail merge, galleries, etc.), and using desktop publishing software to create various types of publications" (McREL, 1997, p. 2).

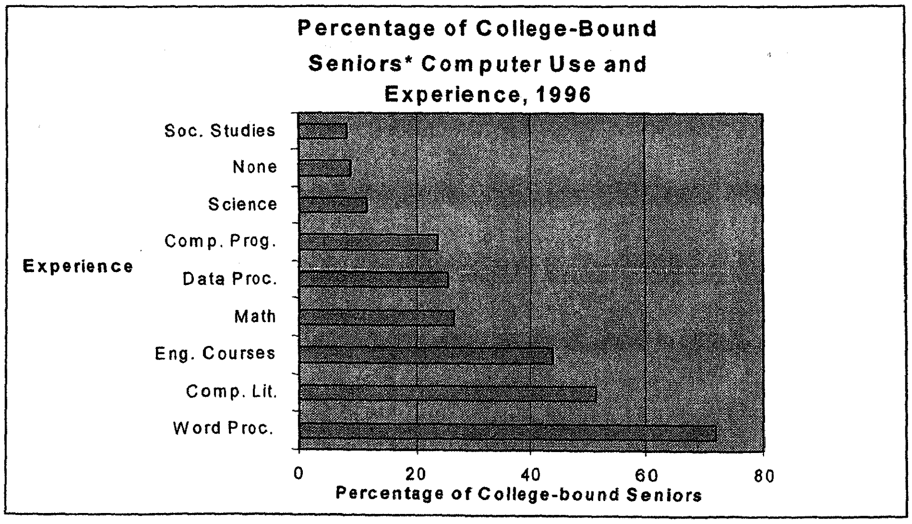
Sufficient standards and benchmarks have been created in order to develop a computer literacy assessment that will determine an individual's skill level on a variety of applications and knowledge. In 1997, North Carolina, Alabama, Tennessee, Georgia, Florida, Texas, Virginia, New Mexico, Louisiana, and South Carolina had some type of exit exam before students received a high school diploma (Coley, et al., 1997, p. 17). Alabama and North Carolina have implemented technology courses into their requirements as have schools such as Lake Washington School District (where all computer skills are routine by the seventh grade) and Manitoba Education and Training in Canada. The movement toward state standards has increased, as individuals understand the importance of technology in our economy and lives and requirements for graduating from high school change to meet present day needs.

Believing that all students should use and understand technology, the North Carolina State Board of Education established a computer proficiency requirement for graduation in May 1991 that required each student to pass a computer skills test before receiving a high school diploma. "Every student should have the opportunity to become computer proficient and every student will take the test as a way of demonstrating proficiency" was the mandate set forth by the state board of education (North Carolina Department of Public Instruction, 1998, p. 2).

The Computer Skills Curriculum for the state of North Carolina "prepares students to use computer technology for school, work, and personal use, for accessing and applying information, for problem-solving, and for communicating ideas and data" while also including objectives for students to "understand the societal uses and impact of technology and to exhibit ethical behavior in using technology" (North Carolina Department of Public Instruction, 1998, p. 2). Prior to graduating from high school, all students must pass a computer skills test to prove they are computer literate in keyboarding, word processing, spreadsheet, database, and use of the Internet.

To give some perspective on computer courses taken by seniors and their use of the computers, the National Assessment of Educational Progress (NAEP) completed a study of the graduating class of 1996. Only 51% of college bound seniors had taken a computer literacy course before they graduated from high school (Coley, et al., 1997, p. 30). Table 5 represents the percentage of college bound seniors use or experience with computers in 1996.

Table 5: Percentage of College-Bound Seniors* Reporting Computer Use or Experience, 1996 (* of those who took the SAT)



The research from the study examines only those students who are planning on attending college and who have taken the SAT. From the results, the NAEP concluded "females and minority group students were less likely than males and white students to have such (computer) experience" (Coley, et al., 1997, p. 32). It is worthy to note that 9% of the students who plan to attend college had no experience on the computer. In 2001, the numbers of students who use the computer have increased due to continued efforts to get hardware into the schools, but as discussed in Chapter 1, not all students have equal access to the hardware.

The North Carolina Test of Computer Skills and other standards are widely supported by groups throughout the United States and the world. The International Society for Technology in Education (ISTE), along with the National Aeronautics and Space Administration, U.S. Department of Education, the Milken Exchange, and Apple Computer, Inc., developed the National Educational Technology Standards (NETS) for students. Their goal was to create a technology-based standard that all United States schools would use to help students become technologically literate. The overriding objective was to include technology skills as a basic skill in all U.S. schools.

In an attempt to raise achievement of students and update curriculum, many school districts and states have implemented technology requirements. "One of the principal recommendations of the National Commission on Excellence in Education was that high school students take more courses in the 'New Basics'—English, mathematics, science, social studies and computer science" (Coley & Goertz, 1990, p. 5).

In 1990, there were "eight states in which high school graduates must have completed course work or demonstrated proficiency in computers; five more include computer science course work in their college preparatory curriculum requirements" (9). Even with the number increasing to 15 across the nation by 1998, to date in Iowa, there are no uniform technology requirements or exit exams required to graduate from high school. In 1999, the only standard Iowa had was attending school from age 7 to age 16 (Jerald & Orlofsky, 1999, p. 82). Considering the Cyberstates report statistics, it seems important for Iowa to determine the level of technical skill students possess and push to make it mandatory for all students.

Jerald and Orlofsky (1999) reported on states' progress in regard to technology and funding available for each state. Iowa has been a leader in the amount of money allocated for improving technology hardware and training for teachers. In 1996, Iowa passed the School Improvement Technology Act which set aside $30 million per year for the following five years to further school technology. Recently, Iowa lawmakers extended the funding until 2003 (p. 82).

In Iowa, each school district receives a share of the money based on its student population (Jerald & Orlofsky, 1999, p. 82). "Among other things, the funds have helped to support an effort to connect every district to the Iowa Communications Network, the state's fiber-optics network" (p. 82). This provides each connected school with "T1 access to the Internet, distance-learning capabilities, and long-distance telephone service."

"Other school technology funding in Iowa comes in the form of federal E-rate discounts and Star School grants, which aid distance-learning efforts" (Jerald & Orlofsky, 1999, p. 82). The Iowa Star School grant provides $8 million dollars a year, half of which goes directly to local schools. Training for teachers is also provided through these funds and is initiated by the state's 15 educational service agencies.

Despite the funding and support in the state of Iowa for technology, the state doesn't meet the suggested student-to-computer ratio for multimedia computers ratio established by the U.S. Department of Education (Coley, et al., 1997, p. 13). In 1997, Iowa's ratio was 19.3 students to one multimedia station, almost four times the recommended ratio of 5:1 (p. 16). Iowa had 80% of its school districts connected to the Internet (although student accessibility is not listed), 73% had CD-ROMS, 45% had Local Area Networks (LANs), and 17% had satellite technology (p. 28). While there has been progress made in funding provided for technology by the state and federal governments, no measure has been created or used to determine whether the increased money being spent has increased the computer skill level and workplace readiness of Iowa students.

Leaders from the Des Moines Public Schools appear to understand the importance of computer skills in today's world. They included technology as one of the Essential Learnings for the district in 1998. The district identified seven basic skills, called Essential Learnings, through federal, state, and local research and validated through a collaboration of district staff, business, labor, community partners, students, and parents. Technology was listed as a basic skill, but presently, no requirement exists for high school graduation that includes technology. All other Essential Learning skills (reading, listening, speaking, writing, mathematics, and science) are included as part of the district's graduation requirements. However, even with the expanded skill set, no graduates, through the class of 2001, had technology as part of their graduation requirements. With state funding that supports technology, students' skill level using technology should reflect the availability of computers and their proficiency using it.

When Iowa's computer availability statistics are compared to the nation's, Iowa appears to be doing fairly well. However, for a state that has been an educational leader, and with funding provided from the both the federal and state government for technology, students should not be graduating from high school without the skills necessary for a changing workforce (Hadley, 1998; Caldwell-Johnson, 2000; Herman, 1999).

"The influence of technology in almost every field or professional endeavor is increasingly pervasive. If American education is to remain relevant, it must account for these changes in its curriculum. Technology is key to a strong and vibrant 21st century American economy. Workers fluent in both how to think with and use technology will make the workplace more effective, increasing productivity and helping ensure America's competitiveness in a global economy. The time to begin preparing our children for the realities of the new American workplace is now" (Lemke & Coughlin, 1998, p. 15).

Conclusion

Many conclusions and questions can be drawn from the research. Schools are attempting to remedy the lack of technology access and skill development but they can do more to provide solutions for educating individuals at school or on the job, to recognize and limit the differences in equity as much as possible, and to expand the resources in this country. Along with educational leaders, business and governmental leaders will need to add input and money to upgrade the quality and quantity of technology, training, and testing in the schools.

Leaders in business organizations and educational institutions believe that students should be prepared for the world in which they live and technology is presently an important factor in our society (Herman, 1999; Milken, 1998). Banta and Kuh (1998) stated the need for further research in which professionals "need to know where learning occurs and what changes will enhance it" (p. 42). Technology is a factor in helping students prepare for the world in which they live, as well as for enhancing the curriculum presently being taught.

"Most of business, the public, and the education community believe that some kind of educational reform is necessary if students are going to be prepared to be productive citizens of the twenty-first century" (Schiff and Solomon, 1997, p. 49). "Technology is at the heart of businesses that will remain competitive and survive into the 21st century. Without technology, they won't" (p. 74). The same is true of our workforce. If individuals have technological skills, they will remain employable. Without the skills, they will not.

Benefits from educating and preparing our students to use technology include, but are not limited to, students having skills to help them become productive, employable citizens. In addition, students would develop a sense of purpose in learning and see relevance to "real life" experiences in their education. Businesses would have workers prepared for a changing workforce. Training costs would be reduced and productivity would be increased with more time on the job instead of in training. With additional skills, there would be less unemployment as individuals would have the skills needed to obtain available positions. An individual's ability to obtain high skilled positions and better pay would increase. Finally, businesses would be able to hire workers to fill highly skilled positions and Iowa's ability to maintain and attract highly skilled businesses would improve.

This study determined the level of basic computer concepts and word processing skills that selected Central Iowa high school seniors possess. With this information, it is the hope of the researcher that the educators in Iowa will better understand the need to teach and require technology as a skill necessary for graduation from any Iowa high school.

Chapter 3

METHODOLOGY

In this chapter, instrumentation, research design, subjects, selection, collection of the data, and data analysis procedures are discussed. The main and secondary research questions are listed to remind the reader of the purpose of the study.

> *H1*: Central Iowa high school seniors possess the computer literacy and word processing skills needed to achieve a passing score on the Tek.Xam assessment examination.
>
> *HO*: Central Iowa high school seniors do not possess the computer literacy and word processing skills needed to achieve a passing score on the Tek.Xam assessment examination.

- Is there a difference in the scores between males and females?
- Is there a difference in scores between those students who have access to a computer at home and those who do not?
- Is there a difference in scores between those who have a computer available for schoolwork and those who do not have one available?
- Is there a difference in scores between those who have taken a computer-related course beyond keyboarding and those who have not?
- Is there a difference in the scores between schools of various sizes?

Instrumentation

The instrument used to determine the level of skill seniors possess was the Tek.Xam assessment examination developed by the Virginia Foundation for Independent Colleges. The test was developed by faculty members as well as corporate human resource and information technology executives. The "five part, Internet-based, vendor-neutral test is delivered online in a proctored computer lab" (Tek.Xam, 2001, p. 21). Test items were tested nationwide on 44 college and university campuses in 22 states in October 1999.

The Tek.Xam assessment evaluation is a way for college students in liberal arts and non-technical majors to demonstrate the computer skills necessary for a number of careers and "is intended to measure computer technology and problem-solving skills within the technology environment" (Tek.Xam, 2001, p. 2). Successful completion of the exam demonstrates computer literacy. It is also used by students finishing college, in non-computer majors, as a way to demonstrate computer skill competencies desired by the workplace.

Five, one-hour modules are included in the assessment and include: general computing concepts, web design, presentation software, spreadsheets and word processing. The complete test requires five hours to complete. Due to difficulties in releasing students for a full day, and lack of compatible resources, only two modules, word processing and general computing concepts, were used in this study. These two modules align closely with the needs of employers and are recognized by educators as being important.

Participant's scores were compared to the passing scores established by Tek.Xam to determine if standards were met. A score of 226 is considered acceptable for the General Computing Concepts module and 221 is considered acceptable for the Word Processing module. Appendix C from the Tek.Xam Training Manual (2001) lists objectives for each module as well as skill areas and objectives. A comprehensive list of specific objectives for the computer concepts module is included in Appendix D.

Test Norms

"Scores on Form IV (academic year 1999-2000) were standardized to a mean of 230 and a standard deviation of 13 1/3, with a minimum of 190 and a maximum of 270 for each Skill Area" (Tek.Xam, 2001, p. 8). A table of norms in the form of percentile ranks is included in Appendix G. This data includes only students who attempted each Skill Area.

Reliability

The reliability of a test refers to its ability to obtain consistent scores by the same person when examined on different occasions. Tek.Xam used coefficient alphas and phi-coefficients to determine a core reliability within each section of the test (keyboarding, word processing, spreadsheets, and databases) as well as the reliability of test scores in total. The average coefficient alpha for forms II, III, and IV are reported in Table 6 for each of the Skill Areas.

Table 6: Reliabilities

Subscale	Form II	Form III	Form IV
General Computing Concepts	.91	.91	.92
Web Design	.95	.95	.94
Presentation Software	.91	.93	.92
Spreadsheet	.91	.88	.91
Word Processing	.81	.75	.76

"Form IV had the largest sample size so the reliability estimates from Form IV are likely most predictive of the reliability with other samples. Because reliability was high for the General Computing Concepts Skill Area in Pilot Forms II and III, this Skill Area was shortened by 15 items for Pilot Form IV (and Spring 2000 operational test), resulting in a minimal loss of reliability. It was further shortened, to 49 items for the 2000-2001 academic year; because the items were chosen carefully, the reliability stayed about the same (.90)" (Tek.Xam, 2001, p. 10).

"Reliability on the open-ended performance tasks was also estimated through generalizability analysis, with both raters and items treated as sources of error. However, there was very little rater variance (or rater by item or rater by person interaction variance), so the phi coefficients from the generalizability analysis were nearly identical to the coefficient alphas" (Tek.Xam, 2001, p. 10). Table 7 contains estimates of the phi-coefficients for the word processing portion of the assessment based on different test lengths and numbers of raters. The estimates for the phi-coefficients for web design, presentation, and spreadsheets are found in Appendix H.

Table 7: Phi Coefficients

	Half as many items as current Length	Current Length	50% more items than current Length
Word Processing			
1 rater	.65	.76	.82
2 raters	.68	.79	.85
3 raters	.69	.80	.86

Validity

Tek.Xam has reported data relating to face, predictive, and construct validity of the test. Further studies are being conducted on the validity of the first and second Tek.Xam assessment evaluations. The following is a summary of known information regarding the validity of the assessment.

Corporate representatives and focus groups composed of Virginia Foundation of Independent Colleges (VFIC) faculty members, academic deans, career service directors, computing directors, and library staff examined the first draft of the test objectives. Based on comments from these people, the Planning Group, composed of faculty and administrators, revised the objectives and drafted the first version of Tek.Xam. The first version was distributed to a Business Advisory Group; a 15 member team consisting of organizations, including GE Financial Assurance, First Virginia Banks, Inc., and EDS, provided feedback. Based on feedback provided by the corporate group, as well as information gathered by the Planning Group, the first pilot form (Pilot Form I) of Tek.Xam was composed.

A group of 52 students from 12 colleges in the VFIC took Pilot Form I in November 1998. Based on these results, the exam objectives and the test were revised and Pilot Form II was administered to a group of 193 student from 12 VFIC institutions and two public universities in February 1999. After considering the item analysis from Pilot Form II (including consideration of item-total correlations, proportion correct, proportion of students choosing each distracter), surveys of examinees, and additional corporate feedback, 11 items were replaced. Pilot Form III was administered to 108 students from eight colleges and universities in July 1999.

After considering the results of Pilots II and III, subscales with few items and low reliabilities were combined. The General Computing Concepts Skill Area was reduced by 15 items when the results showed that deleting 15 items with low item-total correlations would have little impact on reliability. This provided an opportunity to pilot 15 new items (which were not used in calculating student scores). Pilot Form IV was administered in October 1999 and January 2000. A total of 1044 students participated in the administration of Tek.Xam, Form IV, in March and April of 2000.

Students participating in the pilot tests of the Tek.Xam were volunteers interested in certifying their technology skills and represented diverse groups. In Pilots II, III, and IV, about 30% of the students identified themselves as non-White. Roughly half the students were female. Community colleges and historically Black colleges and universities were included. Some students had computer science backgrounds; most did not. Detailed information on the sample is provided in Appendix D (Tek.Xam manual, 2001, p. 5).

Employers and faculty, in order to assure continued content validity, are conducting further evaluations to match test items and objectives. Additional studies are being conducted through the company, Tek.Xam, to determine if the assessment has predictive validity. At the time of this study's publication, no conclusive data had been reported.

Research Design

This quantitative study was a non-experimental design using a single group of individuals at one point in time. Selected students were compared to the standard set by Tek.Xam. In notational form, the design can be depicted as:

X O

O*

where:

X = Experiences or classes students had prior to the survey

O = Survey

O* = Standard for the group as established by Tek.Xam

Subjects

The target population for this study was all high school seniors in the state of Iowa. The accessible population was seniors located in metropolitan Des Moines and surrounding communities. Subjects included all seniors in the graduating class of 2002, except those needing special modifications such as extended time or reading the test or those graduating after the first semester.

The test was timed and administered on-line in proctored labs. The researcher did not have the ability to alter the setting in which the Tek.Xam was distributed. Therefore, accommodations could not be made for students with special needs and they were excluded from the study.

Selection

Schools in Area Educational Agency 11 in central Iowa were selected as the target population in the study. To assure representation of students in the sample, stratified random sampling was used to select schools within the target population.

Four schools were chosen for the study by dividing the school districts within the target population into small, medium, large, and non-public high schools. School district enrollments from the 1998 school year (Iowa Educational Directory, 1998) were used to stratify groups for this study.

In the target population of Central Iowa schools, there were 30 small schools with district enrollments of 1000 or less, 20 medium schools ranging between 1001-4000 students, and five large districts with 4001 or more students. Three non-public schools were included in the target population with enrollments ranging from 307-1182 students. Schools were divided according to their enrollment size and one school was drawn randomly from each stratum to generate the sample of school districts.

After initial contact with each of the districts, two districts were unable to participate due to time constraints and inability to fulfill the requirements of the study, so two alternate schools were randomly selected from the remaining districts in the strata. The enrollments for the schools selected to participate in the study are included in Table 8.

Table 8: Participating Schools' Enrollments

School Size	Enrollment
Small	934
Medium	1604
Large	8631
Non-public	1182

Once the schools were selected, 30 seniors from each school were randomly selected from an unsorted list of enrolled general education students to participate in the study. Every effort was made to test thirty students; however, various factors such as special education accommodations, early graduations, refusals to test, inability to test based on academic testing or activities occurring in classes, scheduling conflicts, and absences from school reduced the number of seniors available to participate. Alternates were randomly selected for each school in the event that one or more of the original students were unable to test, but again, various factors limited student participation. The number of students who participated from each district is included in Table 9.

Table 9: Students Participating from Selected Schools

District	Number of Students Who Participated
Small	30
Medium	29
Large	28
Non-public	26

Access

After selecting the sample districts, a phone call was made to establish rapport with the principals and discuss the possibility of conducting research at their school. A letter was sent to the principal of each high school explaining the purpose of the study and requesting permission to test a systematic sample of their non-special education students from the senior class (included as Appendix I). The letter was sent via email attachment if the principal(s) preferred that method of delivery.

Once approval was obtained, the high school principal completed a demographic sheet detailing the number of computers in the building, the funds available for technology, software used, student-to-computer ratio, etc. (included as Appendix J).

Procedures

The Tek.Xam was administered in group settings to the seniors from each participating school during the second semester of their graduating year of high school. Problems surveying the individuals were due to absence, lack of knowledge of the time or place, communication in the chosen building, transfer to another educational setting, lack of interest, special accommodations etc.

Participants answered ten demographic questions on a sheet provided by the researcher (Appendix F). Demographic questions included, but were not limited to, gender, age, grade point average, computer courses taken, years in the workforce, plans after high school, school size, and whether or not they had a computer at home. Following completion of the demographic sheet and log-in procedures, directions for completing the test were discussed and the researcher administered the Tek.Xam. Results were compiled by an independent party at the Virginia Foundation for Independent Colleges and returned to the researcher following the assessment.

Human Subjects Protection

Students' first and last names were needed to register for the Tek.Xam. To ensure the rights and privacy of the participants, tests and demographic sheets included only exam IDs. Participants gave their names to a representative from the school and he/she gave students their Exam IDs and passwords. The representatives kept lists on file at the school so results could be given to students once the research was completed. This process assured the students confidentiality and provided a way for the researcher to link the test results with the demographic data. Schools had the opportunity to receive a summary of the data from the researcher once the study was completed.

Data Analysis

The purpose of the study was to determine if central Iowa high school seniors possessed the computer literacy and word processing skills needed to achieve a passing score on the Tek.Xam assessment evaluation. Significance levels were set at .05.

Secondary questions included but were not limited to the following:

- Is there a difference in the scores between males and females?
- Is there a difference in scores between those students who have access to a computer at home and those who do not?
- Is there a difference in scores between those students who have a computer available for schoolwork and those who do not have one available?
- Is there a difference in scores between those students who have taken a computer-related course beyond keyboarding and those who have not?
- Is there a difference in scores between students who attend schools of various sizes?

Responses to the questions were sorted into categories based on the test's objectives and then compiled. Descriptive statistics were used to summarize the average scores of individuals, the range of scores, and students' performance on questions. Analyses of variance (ANOVA) was used to determine whether or not statistical significance existed between groups.

Chapter 4

ANALYSIS OF DATA

This chapter contains the statistical analyses performed on the data collected to either confirm or reject the hypothesis proposed in the study. The purpose of the study was to test the computer literacy and word processing skills of high school seniors in four central Iowa high schools using the Tek.Xam assessment evaluation. Scores were compared to the Tek.Xam standards to determine whether or not students had obtained these skills. Scores were also sorted by various demographic factors including school size, gender, home computer ownership, access to a computer, and prior computer coursework in order to determine the possible effect of these factors on test performance. Secondary questions are listed below:

- Is there a difference in the scores between males and females?
- Is there a difference in scores between those students who have access to a computer at home and those who do not?
- Is there a difference in scores between those who have a computer available for schoolwork and those who do not have one available?
- Is there a difference in scores between those who have taken a computer-related course beyond keyboarding and those who have not?
- Is there a difference in the scores between schools of various sizes?

A total of 113 students participated in the study ranging in age from 17-19 years. The non-public school had a total of only 31 seniors, 3 who were home schooled and two who were ill both days of testing. A total of 26 students from the non-public school were tested, which represented 84% of their senior class. Twenty-eight students, representing

5.4% of the senior class, were tested at the large district. Thirty of 60 students from the small district were tested and 29 of 103 from the medium district were able to test, which represent 50% and 28% of the senior classes respectively.

The information in the chapter is divided into three parts: (1) a discussion of student and administration demographic data; (2) statistical analyses of student scores on the assessment evaluation; and (3) student observations during testing.

Demographic Data:

Table 10 shows the demographic information for all participants in the study.

Table 10: Student's Demographic Information

	Response	Frequency	Percentage
Total Students		113	100.0%
Gender	Male	44	39.0%
	Female	69	61.0%
Size of School	Small	30	26.5%
	Medium	29	25.7%
	Large	28	24.8%
	Non-Public	26	23.0%
Computer at Home?	Yes	104	92.0%
	No	9	8.0%
Computer Available for Schoolwork	Yes, on occasion	29	25.7%
	Yes, all of the time	79	69.9%
	No	5	4.4%
Location to Complete Work at School?**	Regular Classroom	30	26.5%

	Computer Lab	79	69.9%
	Media	74	65.5%
	Center/library	11	9.7%
	Other	0	0.0%
Computer Course Beyond Keyboarding?	Yes	74	65.5%
	No	39	34.5%
Where have you learned computer skills?**	Home	70	61.9%
	Friend's House	10	8.8%
	Computer class	41	36.6%
	Regular class	6	5.3%
	Course outside of school	0	0.0%
	Computer camp	0	0.0%
	Other	6	5.3%
If have access, use it to do homework?	Yes	98	86.7%
	No	15	13.3%
How much computer-related homework do you have each week?	None	16	14.2%
	> One hour	59	52.2%
	1-3 Hours	29	25.7%
	3-5 Hours	7	6.2%
	5-10 Hours	1	.8%
	More than 10 hours	0	0.0%
	I don't do	1	.8%

	homework		
What are your plans after high school?**	Enter the workforce	2	1.8%
	Work as apprentice	3	2.7%
	Attend 2 yr. Tech. College	7	6.2%
	Attend 2 yr. Comm. College	17	15.0%
	Attend 4 yr. Institution	75	66.4%
	Unsure at this time	12	10.6%

** Students responded to more than one item on the demographic sheet and therefore, total percentages are greater than 100%.

Four central Iowa high schools participated in the study, with a total of 113 seniors testing. Of those students, 44 were males and 69 were females. A majority of the students had a computer at home (104) but nine students did not have one. A total of 108 students had a computer available either all the time or on occasion for schoolwork and most of the work was completed at school in the library or in computer labs available in the building. Several students (65.5%) had taken a computer course beyond basic keyboarding. Courses taken most often after keyboarding included word processing or computer applications. An overwhelming 61.9% of students reported learning their computer skills at home, with only 36.3% reporting that they learned computer skills in a class. Interestingly, 14.2% of the students reported having no computer homework (each week). Fifty-two percent reported having less than one hour of homework (each week), and 25.7% reported having less than three hours of homework. Sixty-six percent of the students reported that they were planning on attending a four-year institution after high school and 10.6% were unsure of their plans after graduating.

Principals of each participating high school completed a demographic sheet that addressed questions regarding available technology dollars for the building and district, software used in the building, technology as a graduation requirement, student:computer ratio, and staff comfort regarding the use of technology (included as Appendix J). Results from the administrators' responses are listed in Table 11.

Table 11: Administrator's Demographic Information

Question	Small District	Medium District	Large District	Non-public District
Tech. Money Allocated:				
Building	$15,000	Committee	As needed	$16,000
District	$30,000	$200,000	$550,000	$16,000 (same)
Standard Software	None, but use Microsoft Office	MS Office 98	MS Office 98	MS Office 97
Computer Course Required for Graduation?	Yes—Keyboarding	Yes—Keyboarding or Word Processing	No	Yes—Computer Applications
Computers in Building	98	200	450	20
Student: Computer Ratio	3:1	2.5:1	3.5:1	12:1
All Computers Connected to Internet?	Yes	No—80 are not	Yes	Yes
District Plan to Integrate Technology?	Yes	Yes	Yes	No
Rate the comfort level of your staff:	(5=High Comfort)	(1=Low Comfort)		

Keyboarding	5	5	5	5
Word Proc.	4	4	5	5
Spreadsheets	2	2.5	2	3
Databases	3	2.5	2	2
E-mail	5	5	5	4
Internet Navigation	5	5	3	3

As noted in the table, the money allocated to each district increased with the size of the district's population. While discussing the funding with the administrators, the researcher discovered that many districts pool all monies and have a committee decide the best use of the monies for the district instead of giving each building a specific dollar amount. This appeared to work well for the medium and large districts, who had this type of committee in place. The two schools were pleased with the efforts and decisions made by the committees. Lack of bias and fairness were reasons cited for having a committee make decisions instead of them being made at the building level. The other districts had little money to spend on new equipment, software or training. The majority of the technology dollars were spent on repairs and maintenance for existing equipment.

Three schools required keyboarding, word processing, or computer applications as part of the district graduation requirements. No testing was given at the end of a course to determine the level of understanding, but rather, a passing grade for the course was the criteria used to fulfill the requirement. The large district was the only school that did not require a technology course to graduate from high school.

Three schools had a district plan in place for integrating technology across the curriculum. The small school did not have a plan for integrating technology due to the small number of computers in the building allocated to business education courses (keyboarding, computer applications, word processing). The principal discussed the need for applying technology across the curriculum but worried about the feasibility of such a plan with limited dollars for technology.

All of the principals felt that their staff members were comfortable with and had adequate skills in basic keyboarding, word processing, e-mail, and Internet navigation. They rated teachers' comfort level with spreadsheet and database applications at 2 or 3 (on a scale of 1-5 with 5 as the high score). This was significant as spreadsheets and database applications have been reported as necessary skills employers seek in employees (Hadley, 1998).

When asked about technology support provided within the building, principals stated that district staff development activities, teachers working with other teachers, Area Educational Agencies workshops and individual learning based on need or desire as the predominant methods for learning or accessing technology for classroom use. The small district was the only school without a building technology coordinator and only the large district was able to rely on nearby colleges or universities for support with technology.

To summarize the demographic data, 113 high school seniors from four central Iowa districts were tested. A majority of students had a computer in the home, had taken a computer course beyond basic keyboarding, and had access to computers at school or other locations to complete school work. Administrators from each district had some resources available to assist teachers in developing computer skills but felt that teachers lack sufficient skills in spreadsheet and database applications. "Insufficient funds" was cited by two of the four districts as a barrier in meeting needs of students and staff to improve computer skills.

Analysis of Data:

The main hypothesis and additional questions are reviewed in this section of the chapter. Analysis of Variance (ANOVA) was used to determine the significance of the difference between student scores and Tek.Xam standards. Standard assumptions and tests for ANOVA were used including normal distributions, equal interval scores, randomly selected samples, and equal variances between groups. Analyses were based on factors such as gender, having a computer at home, access to computers in and out of school, computer courses taken beyond basic keyboarding, and school size. Significance levels used in this study were set at the .05 level.

Table 12 represents descriptive statistics from the Tek.Xam based on students' overall scores on the General Computing Concepts and Word Processing Modules.

Table 12: Descriptive Statistics from Tek.Xam Assessment Results

	General Computing Concepts	Word Processing
Number	112*	105*
Mean	207.5	212.2
Passing Score	226	221
Maximum Score	240	243
Minimum Score	190*	190*

*Several students had a score of –1, which meant no attempt was made to take the test and were reported as missing values in the analysis.

Returning to the purpose of this study, the hypothesis and the null hypothesis referred to in Chapter 1 were:

> *H1*: Central Iowa high school seniors possess the computer literacy and word processing skills needed to achieve a passing score on the Tek.Xam assessment examination.
>
> *HO*: Central Iowa high school seniors do not possess the computer literacy and word processing skills needed to achieve a passing score on the Tek.Xam assessment examination.

When visually examining the data, the mean scores of the participating students (207.5 on the General Computing Concepts and 215 on the Word Processing modules) were well below the standard scores on the Tek.Xam assessment (226 for General Computing Concepts and 221 for Word Processing modules). In order to reject the null, the following equation would have been false: H_0: $X - X_s <= 0$. Due to the direction of the difference between the mean scores and the standard scores of the Tek.Xam, it was not necessary to run statistical analyses and the researcher failed to reject the null hypothesis. The following charts display the distribution of scores on the General Computer Concept and Word Processing modules respectively:

Figure 1: General Computing Concepts Mean Compared to the Tek.Xam standard

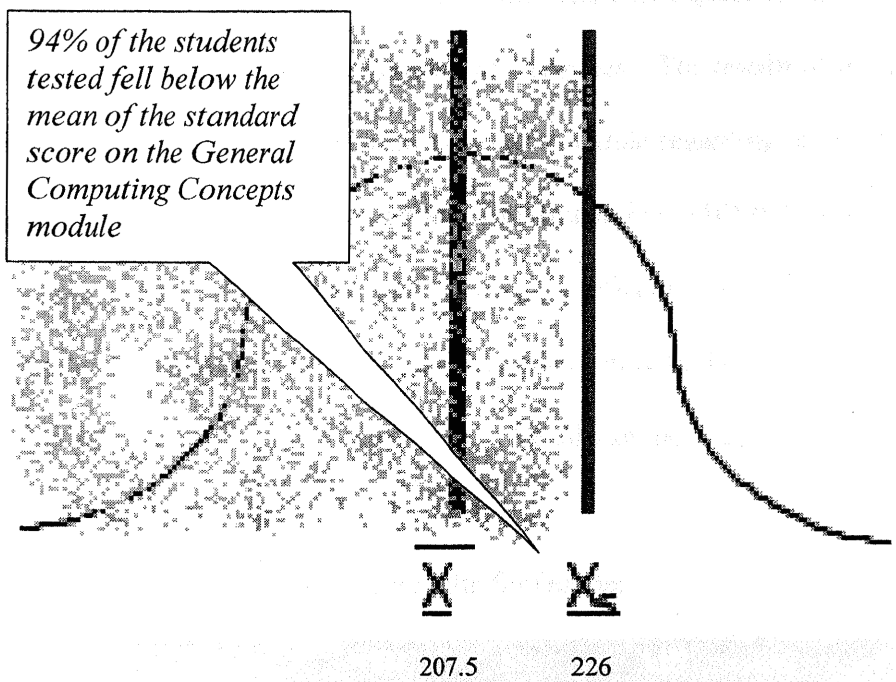
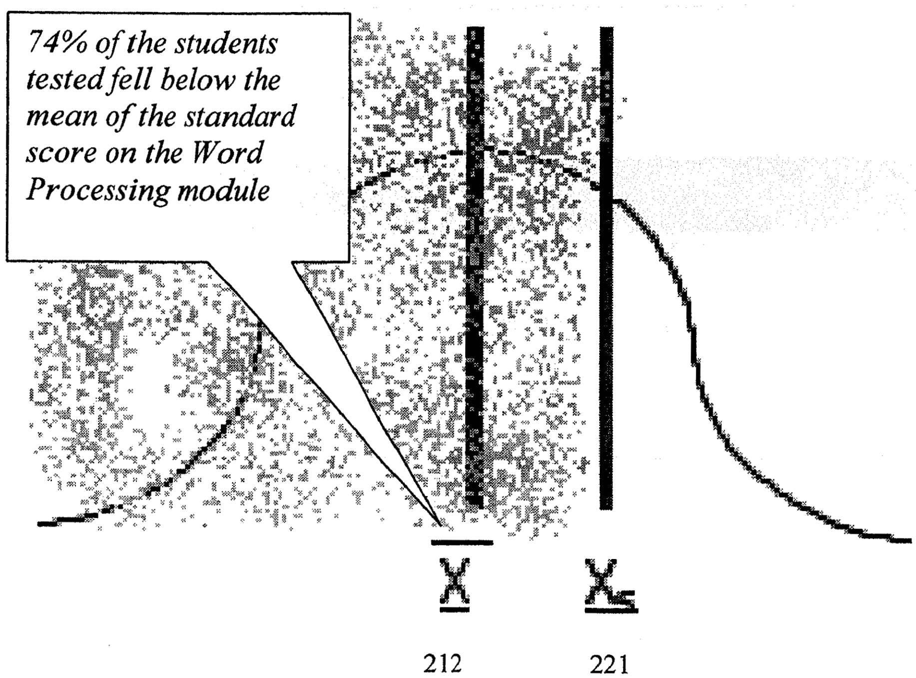


Figure 2: Word Processing Mean Compared to the Tek.Xam standard



Question 1

Beyond the main hypothesis, the first additional question asked was: Is there a difference in the scores between males and females? The results of the analysis of variance for the General Computing Concept module regarding differences between males and females was not statistically significant, $F(1, 110) = 0.14$, $p = 0.71$. The Word Processing module was also not statistically significant, $F(1, 110) = 1.16$, $p = 0.28$. It does not appear that there was a significant difference in the scores of males and females on the Tek.Xam assessment evaluation. Results of the analyses are displayed in Tables 13 and 14 respectively.

Table 13: GCC Module Results for Gender

Source	Df	SS	MS	F	Prob.
Gender	1	15.57	15.57	0.14	0.71
Subjects (error)	110	12664.42	115.13		
Total	111	12679.99			

Table 14: WP Module Results for Gender

Source	Df	SS	MS	F	Prob.
Gender	1	229.91	229.91	1.16	0.28
Subjects (error)	103	20384.89	197.91		
Total	104	20614.80			

Question 2

The next question in the study was: Is there a difference in scores between those students who have access to a computer at home and those who do not? The results of the analysis of variance for the General Computing Concept module regarding having a computer in the home was not statistically significant, $F(1, 110) = 0.29$, $p = 0.59$. The Word Processing module was also not statistically significant, $F(1, 110) = 0.29$, $p = 0.59$. It does not appear that having a computer in the home is associated with a significant increase in students' scores on the Tek.Xam assessment evaluation. Results of the analyses are displayed in Tables 15 and 16 respectively.

Table 15: GCC Module Results for Having a Computer at Home

Source	Df	SS	MS	F	Prob.
Computer at Home	1	33.21	33.21	0.29	0.59
Subjects (error)	110	12646.78	114.97		
Total	111	12679.99			

Table 16: WP Module Results for Having a Computer at Home

Source	Df	SS	MS	F	Prob.
Computer at Home	1	57.76	57.58	0.29	0.59
Subjects (error)	103	20557.05	199.58		
Total	104	20614.80			

<u>Question 3</u>

The third question asked was: Is there a difference in scores between those students who have a computer available for schoolwork and those who do not have one available? The results of the analysis of variance for the General Computing Concept module regarding having a computer available to complete schoolwork was statistically significant, $F(2, 109) = 3.83$, $p = 0.03$. Because this factor had three levels (yes, on occasion; yes, all the time; and no), a post hoc comparison was used to determine which of the mean scores, if any, differed significantly from each other in regard to accessibility to a computer to complete schoolwork. The results of the Scheffé post hoc test are displayed in Table 17.

Table 17: Computer Accessibility for Homework Post Hoc Results for General Computing Concepts

Comparison 1= Yes, on occasion 2= Yes, all the time 3= No	**Difference Between Means**
2 and 3	5.508
2 and 1	5.997"***
3 and 2	-5.508
3 and 1	0.490

****Statistically significant results at .05 level*

A Scheffé test with an alpha level of .05 indicated a significant difference between students who have access to a computer to complete schoolwork on occasion and those who have access all of the time. The mean performance between those with no access and those with access all or some of the time did not differ significantly.

Results from the Word Processing module were not statistically significant, F(2, 109) = 2.78, p = 0.07. It does not appear that having a computer available for schoolwork is associated with a significant increase in students' scores on the Tek.Xam assessment evaluation on the Word Processing module, but it is statistically significant on the General Computing Concepts module. Results of the analyses are displayed in Tables 18 and 19 respectively.

Table 18: GCC Module Results for Computer Access to Complete Schoolwork

Source	Df	SS	MS	F	Prob.
Computer Access	2	832.37	416.18	3.83	0.03*
Subjects (error)	109	11847.62	108.69		
Total	111	12679.99			

*Statistically significant at the .05 level.

Table 19: WP Module Results for Computer Access to Complete Schoolwork

Source	Df	SS	MS	F	Prob.
Computer Access	2	1066.26	533.13	2.78	0.07
Subjects (error)	102	19548.54	191.65		
Total	104	20614.80			

<u>Question 4</u>

The fourth question asked was: Is there a difference in scores between those students who have taken a computer-related course beyond keyboarding and those who have not? The results of the analysis of variance for the General Computing Concept module regarding taking a computer course beyond basic keyboarding was not statistically significant, F(1, 110) = 0.11, p = 0.74. The Word Processing module was also not statistically significant, F(1, 103) = 0.20, p = 0.65. It does not appear that taking a course beyond basic keyboarding is associated with a significant increase in students' scores on the Tek.Xam assessment evaluation. Results of the analyses are displayed in Tables 20 and 21 respectively.

Table 20: GCC Module Results for Students Taking a Course Beyond Basic Keyboarding

Source	Df	SS	MS	F	Prob.
Course Beyond Keyboarding	1	12.53	12.53	0.11	0.74
Subjects (error)	110	12667.46	115.16		
Total	111	12679.99			

Table 21: WP Module Results for Students Taking a Course Beyond Basic Keyboarding

Source	Df	SS	MS	F	Prob.
Course Beyond Keyboarding	1	41.18	41.18	0.21	0.65
Subjects (error)	103	20573.62	199.74		
Total	104	20614.80			

<u>Question 5</u>

The last question asked in the study was: Is there a difference in scores between students who attend schools of various sizes? The results of the analysis of variance for the General Computing Concept module regarding differences in school size were not statistically significant, F(3, 108) = 1.59, p = 0.20. The results for the Word Processing module were statistically significant, F(3, 104) = 5.33, p = 0.002. Because this factor had four levels (small, medium, large, and non-public), a post hoc comparison was used to determine which of the mean scores, if any, differed significantly from each other. The results of the Scheffe post hoc test are displayed in Table 22.

Table 22: School Size Post Hoc Results for Word Processing Module

Comparison 1= Small School 2= Medium School 3= Large School 4= Non-public School	**Difference Between Means**
3 and 4	1.566
3 and 1	4.185
3 and 2	13.185***
4 and 3	-1.566
4 and 1	2.619
4 and 2	11.619***
1 and 2	9.000

****Statistically significant results at .05 level*

A Scheffe test with an alpha level of .05 indicated a significant difference between students who attend medium schools and those who attend large schools and those who attend medium sized schools and those who attend non-public schools. This analysis revealed that students who attended the large and non-public schools did significantly better than those who attended the medium sized school. The mean performance between other groups did not differ significantly. Results of the analyses are displayed in Tables 23 and 24 respectively.

Table 23: GCC Module Results Based on School Size

Source	Df	SS	MS	F	Prob.
School Size	3	535.38	178.46	1.59	0.20
Subjects (error)	108	12144.61	112.45		
Total	111	12679.99			

Table 24: WP Module Results Based on School Size

Source	Df	SS	MS	F	Prob.
School Size	3	2817.77	939.26	5.33	0.002*
Subjects (error)	101	17797.03	176.21		
Total	104	20614.80			

* Significant at the .05 level

Researcher's Observations

School administrators prepared students differently for testing situations. The small and non-public districts held special meetings with the students prior to the testing day to discuss the importance of seniors' participation in the study and what it would mean to the school and the research. This appeared to help students focus on the test and helped them agree to take a two-hour test. The medium school district forgot testing was to occur on the day the researcher showed up and therefore, students were made aware of the situation via the intercom system in the building. Once gathered, the administrator discussed why they were there and asked for their cooperation in testing. The large district sent letters to the students that stated the test was optional for students so many did not respond to the first testing date. The next testing dates were scheduled for one month later so the students appeared to be confused about whether or not they had to test. Based on these situations, it is possible that organization and communication could have affected the test scores of students.

Students at the non-public school were the first to be tested and had difficulty logging onto the test. The researcher had to call the company to identify the password, which had been changed but not shared with the researcher. This caused some confusion for many students as a twenty-minute waiting period ensued. As testing days continued at other schools, the directions became more streamlined and direct for students. The logon situation was unique to the non-public district and may have affected individual feelings and readiness to take the tests.

Students at the small and non-public schools had difficulty uploading data as multiple users were on the networks. This caused many students to guess at answers as they lost interest in the test or noticed the minimal amount of time remaining to look up the correct answers. Several students asked if the uploading time would create a situation where they would be at a disadvantage because they could not upload data quickly and did not have as much time as others to read and research questions. Several students could not get certain Internet pages to appear due to the network connections in the schools. This caused them to guess on those questions for which they needed Internet access.

Students at the small school had a major interruption during the morning group's testing. The server was overwhelmed by multiple users, which caused the server to crash. After 45 minutes, the students were able to continue testing, but many were disinterested at that point. During the wait, several students shared their frustration with the poor quality of technology in the building and how it discouraged teachers and students from using it on a regular basis.

At both of these schools, several students did not know there was a second exercise to the Word Processing module. This situation occurred with approximately five students. The problem occurred as they clicked on the Submit Answer button to submit the first exercise in the module. They clicked on the button again as they were waiting for the upload, and it automatically registered the second question without them seeing or completing it. This may have skewed the results on the Word Processing portion of the test.

Other observations included lack of interest in the results of the test, interruptions in the school day or schedule, illness, frustration with the technology and lack of purpose in doing well on the test. Students participating in the test were generally cooperative, however, it was difficult to test for two hours with no vested interest in the test or the results.

In summary, statistical significance was reported on the General Computing Concepts module in relation to students' access to a computer for schoolwork and on the Word Processing module in relation to the size of school a student attends. However, no statistical differences were reported on either of the modules for the other factors including gender, computer availability in the home, access to a computer, courses taken beyond basic keyboarding and school size.

Seven students achieved a passing score on the General Computing Concepts module of the Tek.Xam and 41 students achieved a passing score on the Word Processing module. The null hypothesis could not be rejected and the researcher acknowledges the possibility of a Type II error. Several student observations are included in this chapter as a basis for discussion of the findings in Chapter 5.

Chapter 5

SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This chapter provides a summary of the study as well as discussions, conclusions, and recommendations for further research.

Summary:

Statistically, students in central Iowa did not have a high level of computer literacy and word processing skills when compared to the standards on the Tek.Xam assessment evaluation. Observations during testing and scores on the test support the conclusion that students did not have the knowledge needed to pass the Tek.Xam assessment evaluation.

The results showed statistically significant differences on the General Computer Concepts module between students who had access to a computer for schoolwork all of the time and those who had access on occasion. There were also statistically significant differences between the scores of students from the medium school and students from the large and non-public schools on the Word Processing module. No statistically significant results were reported in relation to gender, those who had computers at home and those without or those who had taken a computer course beyond basic keyboarding and those who had not.

The statistical analysis of the comparison of student performance to the exam's standards failed to provide sufficient evidence to reject the null hypothesis, so the researcher accepts the null acknowledging the possibility of Type II errors. A type II error occurs when "a false null hypothesis is not rejected" (Wright, 1986, p. 412). A type II error would occur in this study if, in fact, students in central Iowa do have the computer literacy and word processing skills needed to pass the Tek.Xam assessment evaluation and the null hypotheses were not rejected.

Discussion

The discussion section will be divided into six sections: general discussion relating to research, statistical significance, practical significance, instrumentation suggestions, differences in technology between the participating schools, and monetary distributions for technology in the districts.

General Discussion Relating to Research

The research findings presented in Chapter 2 discuss wage differences between people with and without technical skills, shortages of workers with technical skills in the United States and Iowa, suggested student to computer ratios in schools, and curriculum standards that have been set for educators by business and educational organizations and the government. This section deals with each of these issues and the findings of this study.

Based on the results of this study, it could be projected that students in central Iowa will face lower paying jobs in the future because of inadequate technical skills desired by the employers (Caldwell-Johnson, 2000; Herman, 1999). Iowa presently ranks 47^{th} in high-technological jobs across the country and the findings of this study confirm the skill level of individuals in the state. If Iowa does not improve the level of technical skills of future and current members of the workforce, the state will lose opportunities to attract technology firms wishing to enter the state and needing a skilled workforce. This will cause the economy of the state to suffer.

Another factor examined in the study was the student-to-computer ratio in the buildings. The small district had a 12:1 student to computer ratio and the others had an average ratio of 3:1. That is a significant difference when the national average for student-to-computer ratios in 1999 was 5:1 (Jerald & Orlofsky, 1999). The other schools participating in the study appear to be above the national average in their student-to-computer ratio. However, even with adequate numbers of computers in the classrooms, students did not possess the technical skills necessary to pass the Tek.Xam assessment evaluation. This suggests that hardware may not be the only factor in successfully transferring computer skills to students. Future research needs to be conducted to analyze the methods used to teach technology in the schools as well as the objectives being met.

Finally, several sets of standards, benchmarks, and curriculum have been developed to teach computer skills to students (AASA, 1999; Herman, 1999; BLS, 1999; and ISTE, 1998). However, schools in Iowa do not require that students take a computer literacy course prior to graduating from high school. Based on research that supports greater job opportunity, increased skill levels, and higher pay, all students should be graduating from high school with computer skills that are agreed upon by business and schools. Further research should be conducted to determine how many Iowa schools presently require computer literacy as a graduation requirement, and for those that do, what level of computer skill is necessary to complete the course.

Statistical Significance

Statistically significant results were reported on the General Computing Concepts module between those students who had access to a computer to complete homework all of the time and those who had access only occasionally. There were also statistically significant differences on the Word Processing module between students from the medium sized school and students from the large and non-public schools. Factors that could have affected the researcher's ability to reject the null included reliability and validity of the students' scores, and selection of the sample.

Practical Significance

The results of the Tek.Xam assessment evaluation yielded interesting data. The overall mean of the students participating in the study was well below the standard score on both the General Computing Concepts and Word Processing modules. The standard passing score on the Tek.Xam was 226 for the General Computing Concepts module and 221 for the Word Processing module. Student means were 207.5 and 212 respectively.

The following figures illustrate the difference between the standard scores on the Tek.Xam assessment evaluation and the means of the samples. The average score for students fell well below the standard score. Based on these results, it appears that central Iowa students do not have the computer literacy or word processing skills necessary to pass the Tek.Xam (see figures 3 and 4).

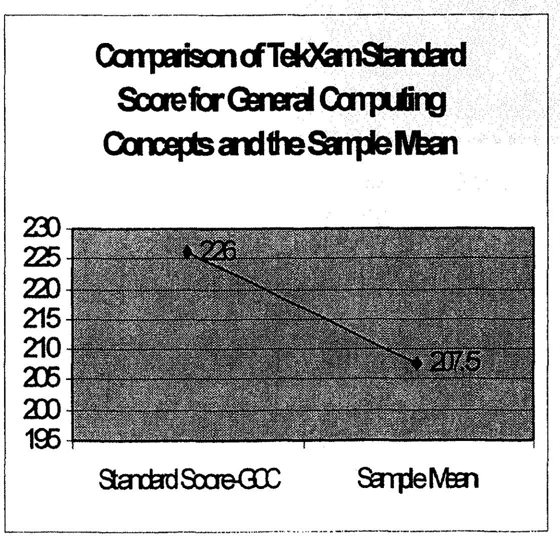


Figure 3: Comparison of Tek.Xam and Sample Mean for GCC

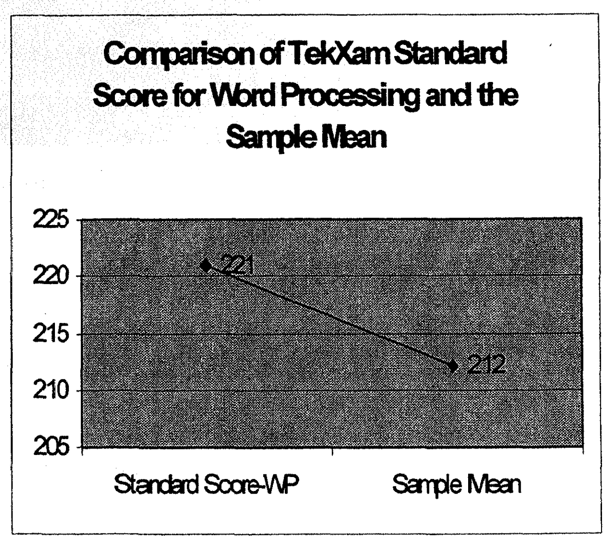


Figure 4: Comparison of Tek.Xam and Sample Mean for WP

Figure 5 compares student scores based on school size and access to a computer for schoolwork. The students from the medium school had the lowest mean score, 204. Next were the students from the small school with a mean score of 213. The non-public school students had a mean score of 215.5, and finally, students from the large school had a mean score of 217. Although there were statistically significant differences between students from the medium and large and non-public schools, no school's mean score were equal to that of the standard. Even though the results showed statistical significance, 94% of the total students did not pass the assessment and therefore, it can be concluded that students lack general computing skills.

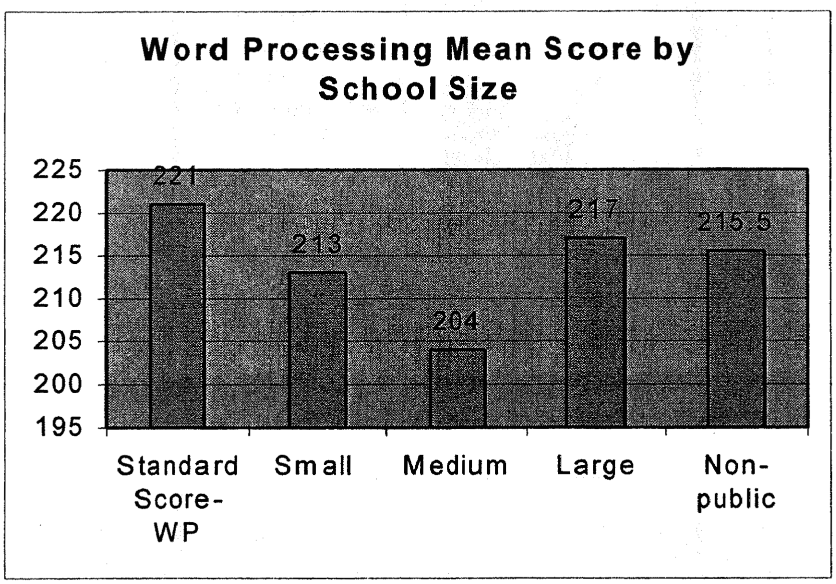


Figure 5: WP Mean Score by School Size

Graphs were constructed to compare groups where statistically significant results were observed. Figures 6 through 11 display the results relating to school size and the percentage of students who fell below the mean score of the comparison group. The large school had the highest mean score (217) and 63%, 84%, and 55% of the students from the small, medium, and non-public schools, respectively, fell below the mean of the large school.

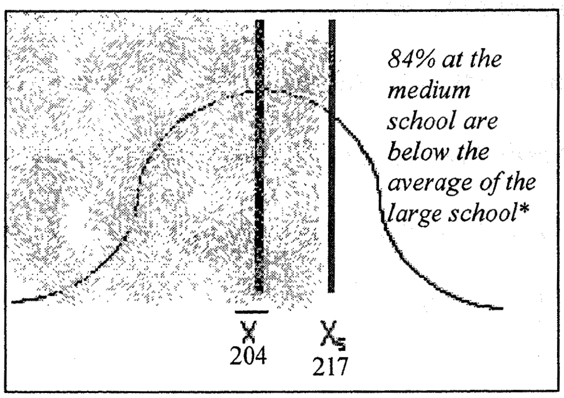


Figure 6: Difference Between Large School and Medium School

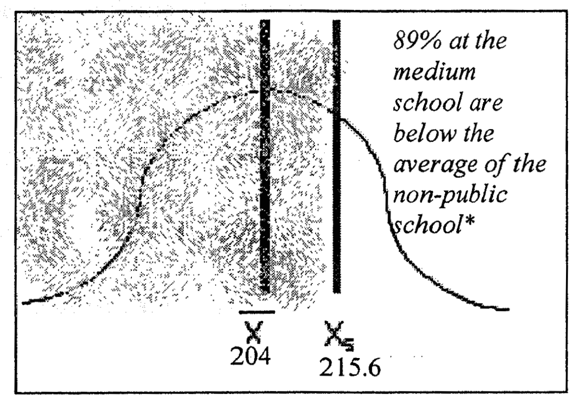


Figure 7: Difference Between Non-public School and Medium School

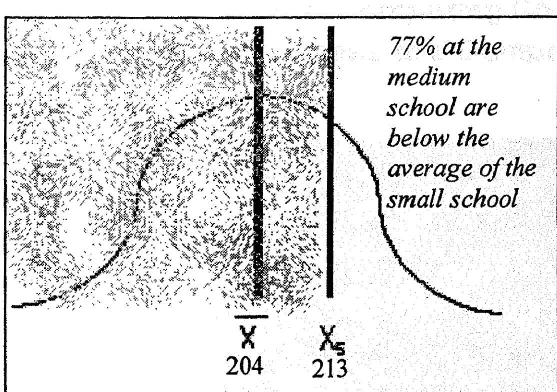


Figure 8: Difference Between Small School and Medium School

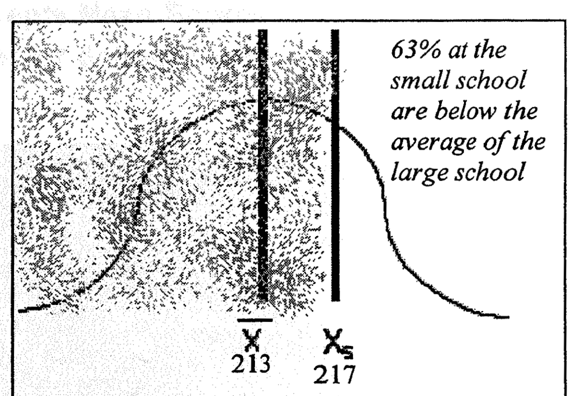


Figure 9: Difference Between Large School and Small School

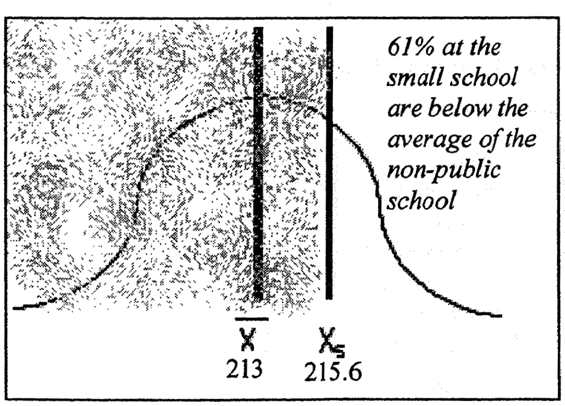


Figure 10: Difference Between Non-public School and Small School

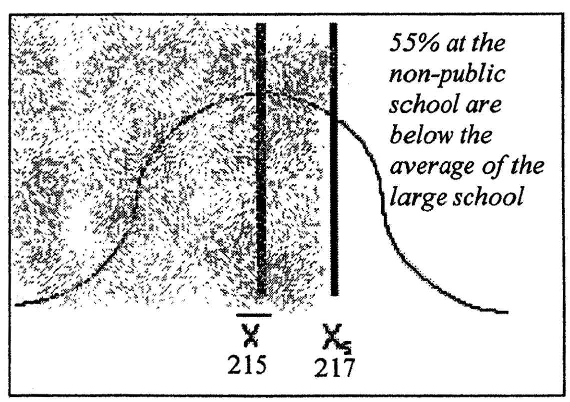


Figure 11: Difference Between Large School and Non-public School

Figures 12 through 15 illustrate the difference between students with access to a computer for schoolwork all of the time, on occasion, or never. The mean score of those students with access to a computer all of the time was 209 and 203 for those with access on occasion. Seventy-two percent of the students with access to a computer for schoolwork on occasion scored less well than the average student who had access all of the time. Interestingly, the students with no access to a computer for homework scored lower than those with access all of the time, but no statistical significance was reported between these groups.

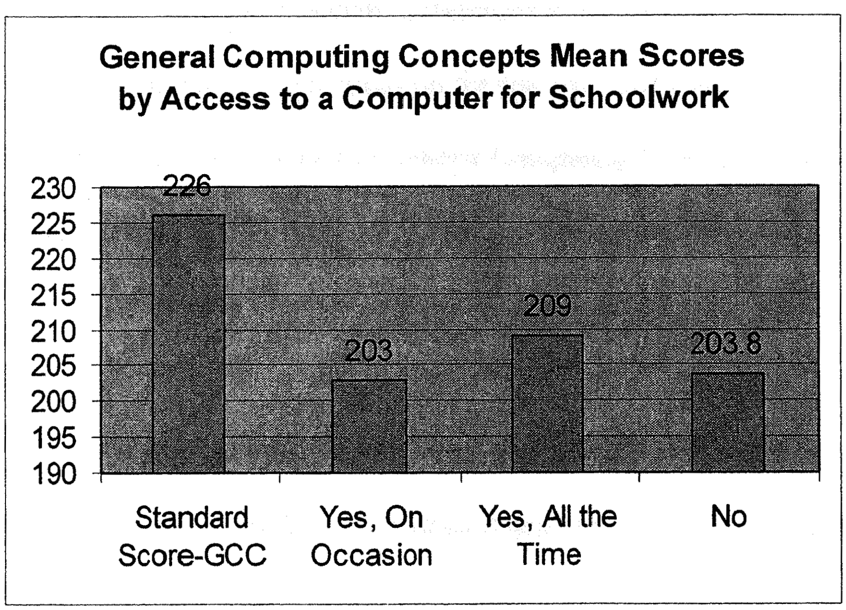


Figure 12: GCC Mean Scores By Access to a Computer for Schoolwork

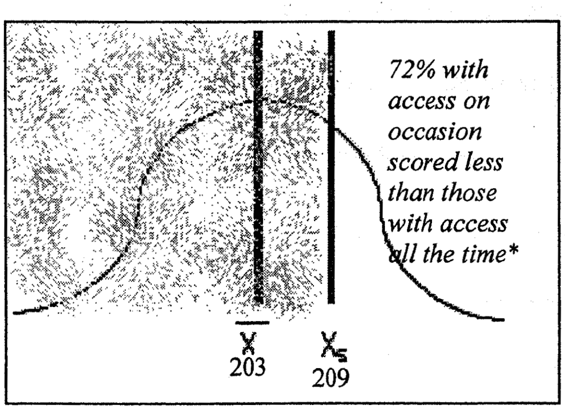


Figure 13: Difference Between Students with Access to a Computer on Occasion and All of the Time

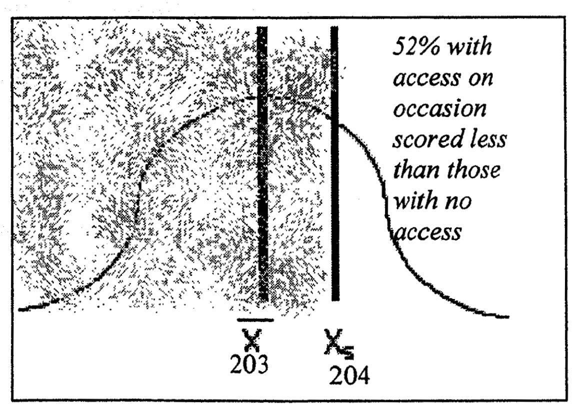


Figure 14: Difference Between Students with Access to a Computer on Occasion and None of the Time

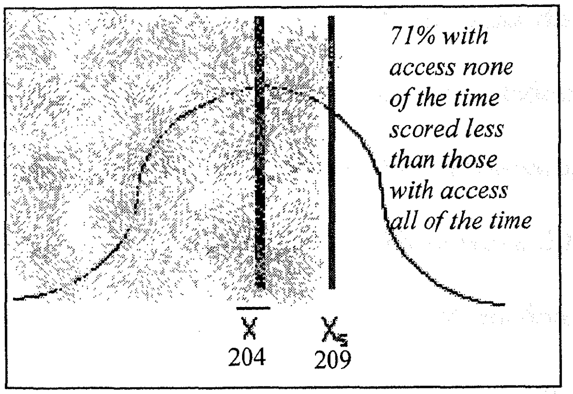


Figure 15: Difference Between Students with Access to a Computer All of the Time and None of the Time

Even though no statistically significant results were reported for other questions in the study, several potentially important differences were observed. For example, while the differences between males and females on the test were not statistically significant, it is noteworthy that no females passed the General Computing Concepts module of the test. Of the females tested, 41% passed the word processing module compared to 33% of the males. This aligns with research which reports males have a greater aptitude toward technology relating to problem-solving and terminology than females and females have a greater aptitude in the applications (such as word processing) (Hoffman and Novak, 1998). This is an area that should be considered important and is recommended for further research.

Students who had a computer at home did not score any better on the Tek.Xam than students who did not have a computer at home. This might relate to studies that discuss the type of activities students use their home computers for such as email, chatting online, games, and Internet searching for music and other areas of interest. Regardless of whether students have computers at home or not, it appears that they are not developing the skills desired by the workplace.

There were no statistically significant differences between those who had taken a computer course and those who had not. Students who had not taken a computer course did almost as well (31%) on the Word Processing module as those students who had taken a computer course (39%). There was a difference in the number of students who passed the General Computing Concepts module, however. Of the seven students who passed, six had taken a computer course. While the majority of students failed to pass either module, students who had taken a computer course beyond keyboarding passes the Tek.Xam at a slightly higher rate than those who had not.

Instrument Suggestions

Instrumentation threats may have been a factor in determining students' scores and the lack of statistically significant findings. The test was two-hours in length. Students worked through each module without a break and fatigue may have affected scores on the test. As the researcher prepared for this study, few instruments existed to test computer literacy and word processing skills of high school students. One such test, in North Carolina, was unavailable and few other affordable tests were on the market for research purposes. Since this study was initiated and completed, several companies have developed, or are developing, assessment tools that measure computer literacy skills.

The producers of the Tek.Xam instrument have recently created and released a new test, Tek.Xam II, that consists of seven 30-question, multiple- choice assessments in the areas of computer literacy, word processing, spreadsheets, web design, databases, presentation, and Internet research. Other companies developing assessment tests include but are not limited to Gateway, Element K, and Net G.

Using a test of shorter length may result in higher levels of enthusiasm by the students, fewer technical difficulties and increased numbers of participants. These factors may contribute to more reliable and valid test scores, although no relationship was evident between the length of the instrument and the results. Continuing studies should be completed to assess the validity and reliability of current tests on the market and to assess the skills that are being taught in the required courses at area high schools.

Differences in Technology Between Schools

Several research studies, including Jerald and Orlofsky (1999), reported access to technology as having a physical computer in the classroom or having a connection to the Internet, but seldom reported on the type of computer hardware, software, or Internet connection in each district. The type of technology, software, and Internet connections varied greatly between the school districts participating in the study. As reported from the administrator demographic surveys, there were extreme differences between the schools in the type of computer hardware available and the network connectivity. The large and medium districts had more funding available to increase the amount and quality of technology in their buildings than the small and non-public districts.

In this study, the small and non-public schools had outdated hardware and slow connections to the Internet. Multiple users on the system caused the servers to crash and delayed testing for students in those districts. This was not a problem for the medium sized district, which had a new computer lab for testing, or the large district, which offered a wireless lab for testing students. The uploading time in the medium and large districts also was not an issue.

Although hardware, software and connectivity differences did not appear to correspond with the statistically significant findings of this study, it could have been a factor that influenced students' scores on the test. Students at the small and non-public schools had to wait while test items were uploaded or during server delays and these could have affected test scores.

Funds Available for Technology

Hardware and connectivity issues are connected to the funding available within each district to improve and update technology. Administrators of the participating high schools reported a range of technology dollars available from $16,000 at the non-public school to $550,000 at the large district. While the large high school did not receive all the money for technology, their potential for obtaining new equipment or labs is much greater than it is for the non-public school. Both the large and medium districts pooled their technology dollars district-wide and allowed a committee to make decisions about technology expenditures. This afforded them the resources to update labs periodically and update servers across the district, rather than just one building.

The small and non-public schools had few technology dollars available. The non-public district was housed in one building, so what they received, as a district, was equal to that of the building. The majority of their technology dollars was spent on repair and maintenance according to their administrator. The small school also had limited funding to support technology and new equipment often was purchased via grants.

The results did not yield a clear explanation of why students did so poorly. The researcher could not establish a relationship between available technology and student scores. For example, the lab at the medium school was new but students' scores were significantly lower than those from large and non-public schools. This might suggest there are other factors to consider, such as teaching methods and computer access. However, the availability of funding for computers and its relationship to student performance should be examined.

Conclusions

Based on the results of the study, the researcher found that:

- Central Iowa high school seniors do not have the computer literacy and word processing skills that are desired in the workplace;
- Students did not perform up to the standard of the Tek.Xam on the General Computer Concepts or Word Processing modules;
- Students at the large and non-public schools scored significantly better than students at the medium school on the word processing module;
- Students who had access to a computer for homework all of the time scored significantly better on the General Computing Concepts module than students with access only on occasion.

Limitations

Several factors could have affected the reliability of the test. The reliability is the idea that an instrument will "consistently produce the same results under comparable circumstances" (Wright, 1986, p. 6). Students not understanding questions and different testing situations can effect the reliability of an assessment. Borg and Gall (1996) suggested several factors that might cause measurement error in a study including inconsistent administration of the test, inconsistent scoring measures, poor testing conditions, variability in individuals, and test items representing only a sample of the abilities, traits, attitudes, and other constructs being measured (p. 255).

In analyzing the design used for this study, several factors were examined beginning with inconsistent administration of the test. Although the tests were administered via computer, the directions were altered slightly at each school in order to help students understand logon and downloading procedures for the specific types of computers in each district. In examining reliability of the tests, it must be acknowledged that this could have produced greater variability in student scores and thus, produced more incidences of statistically insignificant results.

It is also possible that testing conditions could have been a factor in the student's ability to test. Many interruptions occurred during testing situations including announcements over the intercom systems, students and teachers walking into testing centers, bells ringing, and noise from other classrooms or hallways. All of these factors could have had an effect on students' scores. The major factors for the small and non-public schools were interruptions due to server and login failures. As a result, though all students had two hours to complete the test, some students were forced to delay the start, or continuance, of the test by between 25-45 minutes. This must be acknowledged as a factor that could have influenced the test results in those districts.

Students may also have done poorly on the assessment based on individual feelings on the testing days. Feelings relating to parents, friends, significant others, teachers, the researcher, computers, illness, or other reasons could have affected a student's ability to do well on the assessment. Several students were concerned about missed classes, tests, or projects as they were taking the tests, although all students were excused from classes during the testing.

Considering the validity of students' scores leads to the questions, "Does the assessment measure what it purports to measure? And, does it measure what the student has learned?" (Wright, 1986, p. 6). First, the Tek.Xam does appear to measure what it is supposed to measure—the skills deemed necessary by business for the workplace. Businesses, educators, and organizations created the test and included those technical skills deemed necessary for individuals to succeed in the workplace. The second question is more difficult to answer.

The school districts did not have standardized tests to examine the skills learned by students upon completion of a computer course and, further, did not necessarily align their teaching and learning to that of the business sector. Presently, there may be a gap between the technical skills businesses desire in employees and the skills students are learning in school.

Ecological validity refers to environmental factors that might have influenced the student in some way. Two types of ecological validity could have affected student scores including disruption effects and experimenter effects. Disruption effects are those that disrupt a student's normal routine. The medium school did not inform students of the testing so students were taken out of classes to test. The students were not in the proper mindset to take a computerized test and were confused about what they were being asked to do. Students at the large school were also taken out of classes to test. Small groups of students were sent to the counseling office and then forwarded to the researcher.

In addition, students may have performed better if their regular classroom teacher had administered the test instead of the researcher. Several students may have felt more comfortable with a test administrator from their district or building and that may have contributed to experimenter effects.

Regarding population validity, the researcher can only make limited generalizations about the accessible population. Although a random sample was selected from the population, it may have been representative and therefore, the researcher can only make limited generalizations.

Another factor that may have affected the results of the study was the selection of students. Although students were randomly selected, alternate students were used when one of the original students could or would not participate. Several students had conflicts due to scheduling or opted not to test based on other factors. The researcher then tested students who were selected randomly and were willing to participate.

Consequently, the random sample did have a type of volunteerism associated with it and that could have biased the results. This volunteerism in the sample could have biased the sample. It appeared to the researcher that the students who were unable to take the Tek.Xam were students in higher level academic courses. Those students, who may have had higher levels of computer skill, were unable to test and may or may not have scored better on the Tek.Xam than those who replaced them. This scenario only applied to the large and medium school districts since there were no substitutions in the small and non-public districts.

Despite the possibility of type II errors, the researcher believes the null cannot be rejected. Based on observations of the participants, as well as the test results, it appears that central Iowa seniors do not have the computer literacy and word processing skills assessed by Tek.Xam.

Recommendations for Further Research

As this study was completed, a number of possible future research areas surfaced. A list of some of those ideas follows, in the hope that future investigators might consider them.

1. Continue to investigate the level of computer skills in Iowa's high school seniors.

Iowa is a national leader in education and should be examining the level of technology skills its students possess. The results of this study suggest that students do not have the skills desired in the workplace and that should be an area of concern for educators across the state. Several organizations, businesses, and schools include computer literacy skills as a basic skill (Hadley, 1998; Herman, 1999; and Milken, 1998) and researchers should continue to analyze the level of skill students in Iowa possess.

2. Investigate methods and district plans for integrating technology across the curriculum.

Several districts have district-wide technology plans for implementing technology across the curriculum or as requirements for all students prior to graduating (McREL, NETS, North Carolina). Studies comparing districts with technology plans and/or technology as a graduation requirement should be completed to determine the relative effectiveness of various approaches.

3. Analyze technology skills of larger samples of students and districts in Iowa.

http://www.fourhcouncil.edu/ycc/wscans.htm and http://eric-web.tc.columbia.edu/abstracts/ed332054.html.

Tek.Xam Technical Manual. (2001, February). *Tek.Xam: Measuring Problem-Solving and Technology Skills*. Richmond, VA: Virginia Foundation for Independent Colleges.

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It may be possible that the random sample selected did not reflect the computer literacy skills of students in those districts or the state. An expanded study should be conducted to determine if the findings of this study and others can indeed be generalized to the population. Larger groups would also increase statistical power and the researchers' ability to recognize effects.

4. Analyze the scores of high school seniors using the updated Tek.Xam II assessment evaluation, which includes word processing, databases, Internet research, and spreadsheets, or other appropriate computer skill tests on the market.

Since the researcher began this study, several new tests have become available on the market. Additional studies should be conducted using the revised version of the Tek.Xam or similar instruments to compare their reliability and validity.

5. Analyze the comfort level of teachers in integrating technology into the curriculum.

Based on the results from the demographic information collected from administrators, teachers are not comfortable with spreadsheet and database applications, which are attributed to higher-order thinking skills and computer literacy. Therefore, even if a district has a technology plan in place, it cannot be effectively implemented until educators possess the skills to integrate the technologies. Studies relating to teachers' computer skills should be conducted to determine what levels of skill they possess and how their skill levels relates to teaching and learning of computer skills in the classroom (CORD, 2001).

6. Analyze and determine the number of districts with technology plans how they are being integrated across the curriculum.

A study should be conducted to determine how many districts in the state have technology plans and how they are implementing those skills across the curriculum. Another aspect to consider in future studies is research used to support plans and methods for integrating technology.

7. Compare the types of technologies and Internet connections within districts.

Internet connections and numbers of computers are often statistics reported to determine students' access to technology across the state and nation. A study should be conducted to determine the type of software, hardware, and Internet connections the various districts in the state have in their buildings similar to Coley, Cradler, and Engel's (1997) study. The research collected for this study suggests that technologies vary widely from district to district.

8. Evaluate the need to have districts include technology and computer literacy courses and testing as part of the graduation requirements.

Several districts in the study included a computer course as part of the graduation requirements, but none of them had a formal evaluation process to determine what skills students had gained. Iowa currently lags behind other states in assessing technology skills (Education Commission of the States, 1998). A study should be conducted on the various types of assessments used to determine computer skill levels.

9. Discuss the results of the study with businesses to determine if scores on the Tek.Xam, or other assessment, would encourage or discourage hiring individuals.

Many businesses support the Tek.Xam as a measure to determine computer literacy skills of their employees (Tek.Xam, 2001). It is important to understand the impact, if any, of test results for students and employers. Further studies should be conducted to determine if a failing score on the Tek.Xam assessment evaluation would make a difference in the hiring practices of employers in Iowa.

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APPENDIX

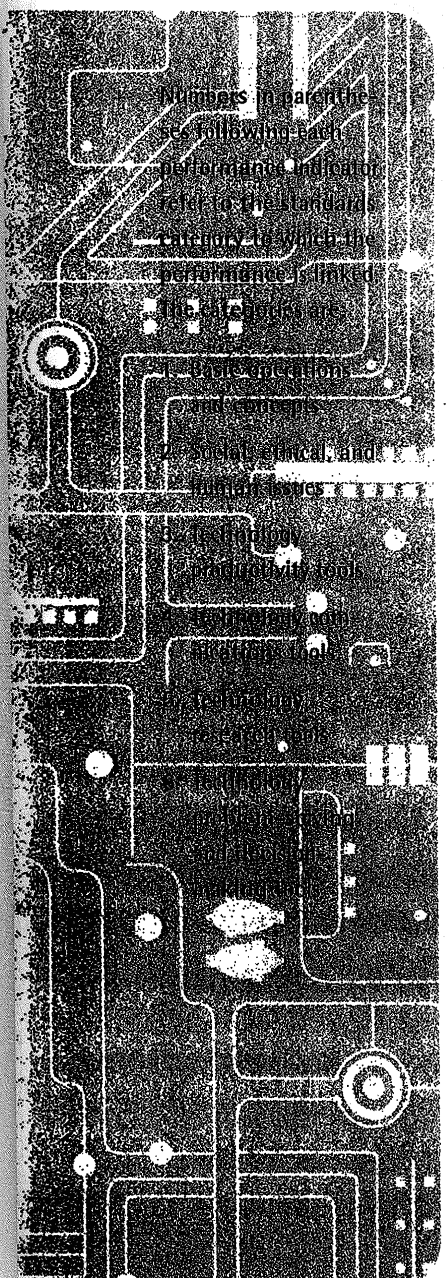
Appendix A

National Educational Technology Standards (NETS)

GRADES PreK–2

Performance Indicators:

All students should have opportunities to demonstrate the following performances.



Prior to completion of Grade 2 students will:

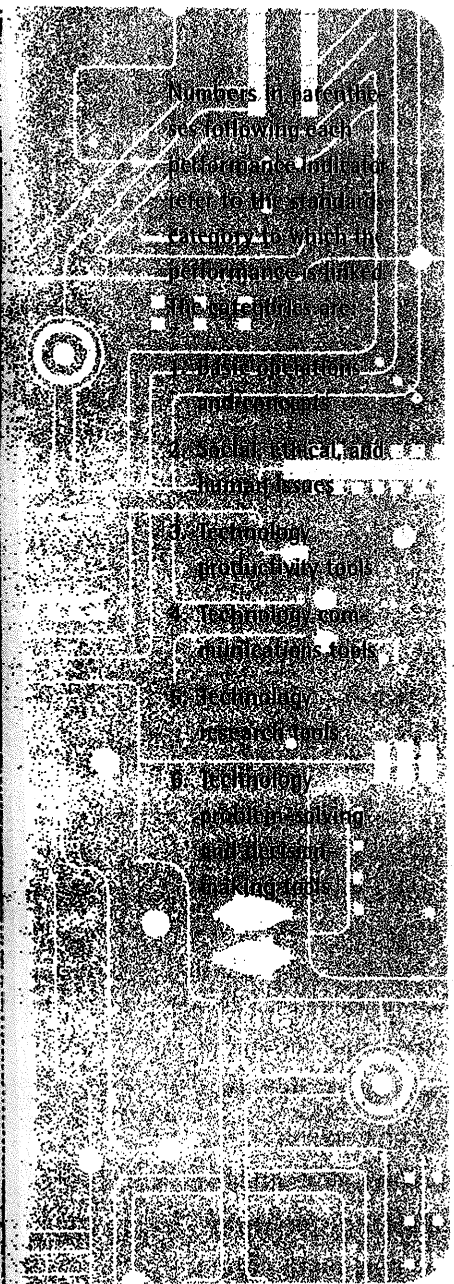
1. *Use input devices (e.g., mouse, keyboard, remote control) and output devices (e.g., monitor, printer) to successfully operate computers, VCRs, audiotapes, and other technologies. (1)*
2. *Use a variety of media and technology resources for directed and independent learning activities. (1, 3)*
3. *Communicate about technology using developmentally appropriate and accurate terminology. (1)*
4. *Use developmentally appropriate multimedia resources (e.g., interactive books, educational software, elementary multimedia encyclopedias) to support learning. (1)*
5. *Work cooperatively and collaboratively with peers, family members, and others when using technology in the classroom. (2)*
6. *Demonstrate positive social and ethical behaviors when using technology. (2)*
7. *Practice responsible use of technology systems and software. (2)*
8. *Create developmentally appropriate multimedia products with support from teachers, family members, or student partners. (3)*
9. *Use technology resources (e.g., puzzles, logical thinking programs, writing tools, digital cameras, drawing tools) for problem solving, communication, and illustration of thoughts, ideas, and stories. (3, 4, 5, 6)*
10. *Gather information and communicate with others using telecommunications, with support from teachers, family members, or student partners. (4)*

Profile for Technology Literate Students

GRADES 3–5

Performance Indicators:

All students should have opportunities to demonstrate the following performances.



Prior to completion of Grade 5 students will:

1. *Use keyboards and other common input and output devices (including adaptive devices when necessary) efficiently and effectively. (1)*
2. *Discuss common uses of technology in daily life and the advantages and disadvantages those uses provide. (1, 2)*
3. *Discuss basic issues related to responsible use of technology and information and describe personal consequences of inappropriate use. (2)*
4. *Use general purpose productivity tools and peripherals to support personal productivity, remediate skill deficits, and facilitate learning throughout the curriculum. (3)*
5. *Use technology tools (e.g., multimedia authoring, presentation, Web tools, digital cameras, scanners) for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom. (3, 4)*
6. *Use telecommunications efficiently and effectively to access remote information, communicate with others in support of direct and independent learning, and pursue personal interests. (4)*
7. *Use telecommunications and online resources (e.g., e-mail, online discussions, Web environments) to participate in collaborative problem-solving activities for the purpose of developing solutions or products for audiences inside and outside the classroom. (4, 5)*
8. *Use technology resources (e.g., calculators, data collection probes, videos, educational software) for problem-solving, self-directed learning, and extended learning activities. (5, 6)*
9. *Determine when technology is useful and select the appropriate tool(s) and technology resources to address a variety of tasks and problems. (5, 6)*
10. *Evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources. (6)*

Profile for Technology Literate Students

GRADES 6–8

Performance Indicators:

All students should have opportunities to demonstrate the following performances.

Numbers in parentheses following each performance indicator refer to the standards category to which the performance is linked. The categories are:

1. Basic operations and concepts
2. Social, ethical, and human issues
3. Technology productivity tools
4. Technology communications tools
5. Technology research tools
6. Technology problem-solving and decision-making tools

Prior to completion of Grade 8 students will:

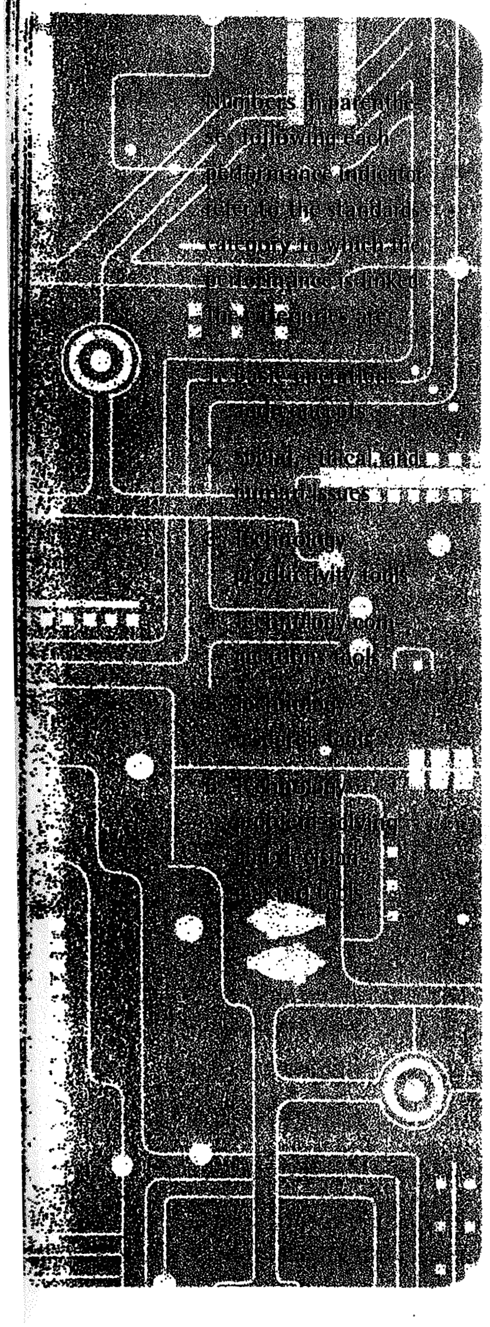
1. *Apply strategies for identifying and solving routine hardware and software problems that occur during everyday use. (1)*
2. *Demonstrate knowledge of current changes in information technologies and the effect those changes have on the workplace and society. (2)*
3. *Exhibit legal and ethical behaviors when using information and technology, and discuss consequences of misuse. (2)*
4. *Use content-specific tools, software and simulations (e.g., environmental probes, graphing calculators, exploratory environments, Web tools) to support learning and research. (3, 5)*
5. *Apply productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. (3, 6)*
6. *Design, develop, publish, and present products (e.g., Web pages, videotapes) using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom. (4, 5, 6)*
7. *Collaborate with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues, and information, and to develop solutions or products for audiences inside and outside the classroom. (4, 5)*
8. *Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problems. (5, 6)*
9. *Demonstrate an understanding of concepts underlying hardware, software, and connectivity, and of practical applications to learning and problem solving. (1, 6)*
10. *Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems. (2, 5, 6)*

Profile for Technology Literate Studen

GRADES 9-12

Performance Indicators:

All students should have opportunities to demonstrate the following performances.



Prior to completion of Grade 12 students will:

1. *Identify capabilities and limitations of contemporary and emerging technology resources and assess the potential of these systems and services to address personal, lifelong learning, and workplace needs. (2)*
2. *Make informed choices among technology systems, resources, and services. (1, 2)*
3. *Analyze advantages and disadvantages of widespread use and reliance on technology in the workplace and in society as a whole. (2)*
4. *Demonstrate and advocate for legal and ethical behaviors among peers, family, and community regarding the use of technology and information. (2)*
5. *Use technology tools and resources for managing and communicating personal/professional information (e.g., finances, schedules, addresses, purchases, correspondence). (3, 4)*
6. *Evaluate technology-based options, including distance and distributed education, for lifelong learning. (5)*
7. *Routinely and efficiently use online information resources to meet needs for collaboration, research, publications, communications, and productivity. (4, 5, 6)*
8. *Select and apply technology tools for research, information analysis, problem-solving, and decision-making in content learning. (4, 5)*
9. *Investigate and apply expert systems, intelligent agents, and simulations in real-world situations. (3, 5, 6)*
10. *Collaborate with peers, experts, and others to contribute to a content-related knowledge base by using technology to compile, synthesize, produce, and disseminate information, models, and other creative works. (4, 5, 6)*

Appendix B

Mid-Continent Regional Educational Laboratory (McREL) Standards

Technology Standard and Benchmarks

Standard 1: Knows the characteristics and uses of computer hardware and operating systems

Level I (Grade K-2)

1. Knows basic computer hardware (e.g., keyboard and mouse, printer, monitor, output, hard and floppy disk, case for the CPU [central processing unit])
2. Powers-up computer, monitor, and starts a computer program (e.g., checks that printer is switched on and on-line; reboots the computer when necessary)
3. Knows the alphanumeric keys and special keys (e.g., function keys, escape key, space bar, delete/backspace, return/enter)
4. Knows proper finger placement on the home row keys
5. Handles diskettes and other computer equipment with care

Level II (Grade 3-5)

1. Knows the basic functions of hardware (e.g., keyboard and mouse provide input; printer and monitor provide output; hard and floppy disk provide storage; the cpu processes information)
2. Uses proper fingering for all keys, beginning from the homerow, maintaining proper posture while using the keyboard
3. Knows potential hazards to computer media (e.g., the damage caused to floppies by magnetic fields, dirt, and dust; caused to computers by excessive heat, smoke, and moisture)
4. Knows basic facts about networked computers (e.g., computers can connect to each other via modem and telephone line, or through local network systems, or internet and intranet)

Level III (Grade 6-8)

1. Knows the differing capacities and trade-offs for computer storage media, such as CD-ROMs, floppy disks, hard disks, and tape drives
2. Types with some facility, demonstrating some memorization of keys
3. Connects via modem to other computer users via the internet, an on-line service, or bulletin board system
4. Knows basic characteristics and functions of an operating system

Level IV (Grade 9-12)

1. Knows of significant advances in computers and peripherals (e.g., data scanners, digital cameras)
2. Uses a variety of input devices (e.g., keyboard, scanner, voice/sound recorders, mouse, touch screen)

3. <u>Knows limitations and trade-offs of various types of hardware (e.g., laptops, notebooks, modems)</u>
4. <u>Identifies malfunctions and problems in hardware (e.g., hard drive crash, monitor burn-out)</u>
5. <u>Knows features and uses of current and emerging technology related to computing (e.g., optical character recognition, sound processing, cable TV, cellular phones, ABS brakes)</u>

Technology Standard and Benchmarks

Standard 2: Knows the characteristics and uses of computer software programs

Level I (Grade K-2)

1. Types on a computer keyboard, using correct hand and body positions
2. Knows basic distinctions among computer software programs, such as word processors, special purpose programs, and games
3. Uses menu options and commands

Level II (Grade 3-5)

1. Uses a word processor to edit, copy, move, save, and print text with some formatting (e.g., centering lines, using tabs, forming paragraphs)
2. Makes back-up copies of stored data, such as text, programs, and databases
3. Trouble-shoots simple problems in software (e.g., re-boots, uses help systems)
4. Knows the common features and uses of databases (e.g., databases contain records of similar data, which is sorted or organized for ease of use; databases are used in both print form, such as telephone books, and electronic form, such as computerized card catalogs)
5. Uses database software to add, edit, and delete records, and to find information through simple sort or search techniques
6. Knows how formats differ among software applications (e.g., word processing files, database files) and hardware platforms (e.g., Macintosh, Windows)

Level III (Grade 6-8)

1. Uses advanced features and utilities of word processors (e.g., uses clip art, a spell-checker, grammar checker, thesaurus, outliner)
2. Knows the common features and uses of desktop publishing software (e.g., documents are created, designed, and formatted for publication; data, graphics, and scanned images can be imported into a document using desktop software)
3. Knows the common features and uses of spreadsheets (e.g., data is entered in cells identified by row and column; formulas can be used to update solutions automatically; spreadsheets are used in print form, such as look-up tables, and electronic form, such as to track business profit and loss)
4. Uses a spreadsheet to update, add, and delete data, and to write and execute valid formulas on data
5. Uses boolean searches to execute complex searches on a data base

Level IV (Grade 9-12)

1. Understands the uses of listservs, usenet newsreaders, and bulletin board systems

2. <u>Knows how to import, export, and merge data stored in different formats (e.g., text, graphics)</u>
3. <u>Knows how to import and export text, data, and graphics between software programs</u>
4. <u>Identifies some advanced features of software products (e.g., galleries, templates, macros, mail merge)</u>
5. <u>Uses desktop publishing software to create a variety of publications</u>

Appendix C

Main Objectives for each of Tek.Xam's Five Modules

1. General Computing Concepts – Defining Computer Terminology, Troubleshooting, and Appropriate Use of Technology; Legal and Ethical Issues in Technology; and Internet Research and Evaluation

Candidates answer selected response questions related to software and hardware components and use thereof, telecommunications, network applications, technical terminology, and problem solving in a technical environment. Candidates demonstrate their knowledge of and application of legal and ethical principals related to computer and Internet use and the collection and dissemination of information in a business environment.

Candidates use an Internet browser and search engine of their choice to find the answers to a set of selected response questions. Candidates determine bias of Internet sites, evaluate quality of information available on those sites, and determine the perspective of the website creator.

2. Web Design – Creating a Website

Candidates create a multi-page website using software of the candidate's choosing.

3. Presentation Software – Creating an Effective Presentation

Candidates create a multi-slide presentation about a given topic.

4. Spreadsheets – Synthesizing, Analyzing and Presenting Numeric Data

Candidates analyze raw data, draw conclusions, create a spreadsheet, graph pertinent data and then export the data to another application.

5. Word Processing – Communicating Data

Candidates create a document using word processing software and incorporate tables and graphs from another application (3).

Each module is designed to reflect inclusion of the given objectives. The objectives of the Tek.Xam are listed as follows:

A. UNDERSTANDING THE OPERATION OF TECHNOLOGY

1. Students will demonstrate an understanding of computer hardware capability, design purpose, and interrelation among peripherals.

a) Capability

b) Design Purpose and Function

c) Interrelation of peripherals

2. Students will demonstrate an understanding of computer software capability and be versed in its uses.

3. Students will demonstrate an understanding of computer network concepts and terms (including Internet).

4. Students will demonstrate an understanding of operating system concepts and terms.

5. Students will demonstrate an understanding of legal and ethical issues in the field of information technology.

B. USING TECHNOLOGY TO RETREIVE, INTERPRET, AND PRESENT INFORMATION

1. Students will demonstrate proficiency in word processing

2. Students will demonstrate proficiency in spreadsheets and use spreadsheets as an analytical tool

3. Students will demonstrate proficiency in presentation software and use presentation software for an effective presentation

4. Students will demonstrate proficiency in web design

5. Students will be able to determine the information requirements for a research question

6. Students will be able to formulate and conduct effective searches of electronic resources including the Internet

7. Students will be able to assess the usefulness and accuracy of information gathered in searches
8. Students will understand Internet concepts and terms
9. Students will be able to determine which technology tools are most efficient to retrieve information
10. Students will be able to determine which technology tools are most efficient to interpret information
11. Students will be able to determine which technology tools are most efficient to present information
12. Students will be able to solve problems in a work environment (4)

Table 6 shows the relationship between the Skill Areas assessed using the Tek.Xam and the objectives given for it.

Table 6: Objectives and Skill Areas

Skill Area	**Objectives**
Skill Area 1: General Computing Concepts	A1, A2, A3, A4, A5, B5, B6, B7, B8, B9, B10, B11, B12
Skill Area 2: Web Design	B4, A2
Skill Area 3: Presentation	B3, A2
Skill Area 4: Spreadsheets	B2, A2
Skill Area 5: Word Processing	B1, A2

Appendix D

Objectives for Tek.Xam's General Computing Concepts Modul

Objective	Explanation of the Objective
AIb4	Explain how a diskette stores data (sectors)
AIb7	Define "RAM" and its purpose
AIb8	Define "megabyte"
AIc1	Identify and define a peripheral
AIc2	Define what it means for a device to be "online" or "offline"
AIc3	Distinguish between an input device and an output device
AII1	Distinguish between productivity software and operating systems
AII10	Identify the components of a jpeg or gif file
AII16	Comprehend the difference between version/release #'s on similar products
AII18	Understand the difference between different types of application software
AIII1	Distinguish between different types of telecommunication media
AIII11	Distinguish between a web site and a newsgroup
AIII12	Define the function of a network hub
AIII15	Distinguish between ASCII and Binary
AIII16	Understand and define "protocols"
AIII3	Identify the function of a Local Area Network (LAN)
AIV3	Define "multi-tasking"
AIV5	Define "firewall"
AV1b	Define Copyright
AV1c	Define Fair Use
AV1e	Define Licensing Agreement
AV1g	Define Plagiarism
AV4	Recognize ethical issues that are unique to technology settings (I.e., privacy, confidentiality, ownership, etc.)
BIII3	Determine the author of a book given the title
BIII6	Find an article in a specified magazine given the author and subject
BIV3	Find a web site and information about a government entity or non-profit org.
BIV5	Access websites using a web browser
BV1	Determine the bias of web sites
BV2	Assess the credibility of information contained in a web site
BV3	Assess the accuracy of information contained in a web site
BVI1g	Define listserv
BVI2	recognize the capabilities of a modem
BVI4	Describe functions of hypertext language
BVI6	Recognize URL suffixes (e.g., .au)
BX2	Recognize that a printer must be "online" in order to print a document
BX4	Recognize that slow application processing means insufficient RAM
BX5	Recognize that low modem speed is the most likely reason that files would download slowly

Appendix E

Description of the Students in the Tek.Xam Sample

Gender		Ethnic Background		Class	
Male	53.2	White, Caucasian	70.5	Freshman	6.8
Female	46.1	Black, African American	9.5	Sophomore	17.3
no response	0.7	Latino, Hispanic	1.2	Junior	30.7
		Asian	9.5	Senior	34.1
		Other	3.8	Post-graduate	5.7
		rather not say or no response	5.0	Associate	0.3
				none of the above or no response	5.0

	Computer Science Courses	Age
number of students who responded	716	718
mean	1.84	23.11
Median	1	21
standard deviation	2.00	6.56
Minimum	0	17
Maximum	13*	55

* one student answered 24 courses, which was judged unlikely (possibly 24 credit hours?)

Appendix F

Student Demographic Sheet Used to Collect High School Seniors' Information

1. Gender:

________Male ________Female

2. ***What size school do you attend?***

_____Small _____Medium _____Large _____Non-Public

3. Do you have a computer at home?

_____Yes _____No

4. ***Do you have a computer to do work outside of class?***

_____Yes, on occasion _____Yes, all the time _____No

5. ***When work is assigned, where can you complete computer work (at school)?***

_____Regular Classroom
_____Computer Lab
_____Media Center/Library
_____Other ___________________

6. If you have access to a computer, do you use it to do school work?

_____Yes _____No

7. Have you completed a computer/technology course *beyond basic keyboarding*?

_____Yes _____No

8. Where have you learned the majority of your computer skills? (Check one)
_____Home
_____Friend's House
_____Computer Class
_____Regular Class
_____Course Outside of school
_____Computer Camp
_____Other _________________________

9. ***On the average, how much computer-related homework are you assigned each week?***

______No homework assigned
______Less than one hour
______Between one and three hours
______More than three, less than five hours
______Between five and ten hours
______More than ten hours
______I do not do homework

10. What are your plans after high school?

_____To enter the workforce
_____To work as an apprentice or in a specialized trade
_____To attend a 2 year technical college
_____To attend a 2 year community college
_____To attend a 4 year college
_____I am unsure at this time

Appendix G

Proportion of Students below each Score[1] in 1999-2000 (Form W)

Score	General Concepts	Web Design	Presentations	Spreadsheets	Word Processing
190	0.0	0.0	0.0	0.1	0.6
191	0.1	0.0	0.0	0.6	1.2
192	0.1	0.0	0.0	1.1	1.2
193	0.1	0.0	0.0	1.4	1.2
194	0.2	0.0	0.0	1.5	1.8
195	0.2	0.1	0.0	1.5	2.3
196	0.3	0.1	0.0	1.5	2.3
197	0.4	0.1	0.0	1.9	2.7
198	0.5	0.1	0.1	2.4	3.2
199	0.6	0.1	0.1	2.5	3.2
200	0.7	0.1	0.1	2.7	3.7
201	0.9	0.1	0.1	3.1	4.2
202	1.4	0.1	0.1	3.9	4.5
203	2.2	0.2	0.2	4.8	4.8
204	3.1	0.3	0.2	5.7	5.5
205	3.8	0.3	0.3	6.5	6.3
206	4.7	0.3	0.4	7.3	7.5
207	5.5	0.4	0.8	8.3	8.6
208	6.3	0.5	1.2	9.3	9.2
209	7.3	0.7	1.7	10.6	9.7
210	8.4	0.8	2.2	11.4	10.7
211	9.0	0.8	2.3	12.0	12.6
212	10.2	0.9	2.6	13.2	13.4
213	11.8	1.1	3.2	14.5	14.2
214	12.9	1.7	3.9	15.7	15.6
215	14.3	2.6	4.7	16.7	16.5

[1] In a continuous scale, percentiles are defined as the percentage of persons scoring below a given score. Defining percentiles is more ambiguous when the scale is discrete and multiple people can have the same score. For Tek.Xam, half of the examinees scoring in an interval, as well as all the examinees below the interval, were included in the percentile rank. An "average" examinee in that interval would score above half those in the same interval and below the other half. This is a fairly conventional, but not universal, definition of percentiles for standardized tests.

216	16.0	3.6	5.4	18.2	16.7
217	18.0	4.1	6.6	19.3	17.4
218	20.2	4.5	7.8	20.3	19.2
219	22.3	5.0	8.6	22.2	21.1
220	24.1	5.7	9.6	24.3	22.0
221	27.0	6.4	11.4	26.3	23.1
222	29.7	7.3	13.8	28.7	25.5
223	31.6	8.6	16.4	31.1	28.9
224	35.0	9.8	20.9	33.6	32.8
225	38.2	11.0	25.4	35.9	34.9
226	39.9	12.9	29.1	38.3	38.5
227	41.7	14.9	33.1	41.3	44.5
228	44.2	17.1	35.7	44.2	46.8
229	46.9	19.6	43.3	47.0	49.6
230	49.8	22.9	50.6	49.6	52.5
231	52.4	26.7	53.3	52.6	55.5
232	54.9	30.6	55.4	55.2	58.5
233	58.0	36.1	56.5	57.6	62.3
234	61.0	42.1	57.7	59.2	66.2
235	64.0	47.1	59.9	60.6	66.2
236	65.8	52.3	62.0	63.6	66.2
237	67.3	56.8	62.0	67.2	70.8
238	70.2	62.9	62.4	69.7	75.4
239	71.6	68.4	62.8	71.0	75.4
240	73.4	72.0	62.8	73.1	75.4
241	76.9	75.3	62.8	75.2	75.4
242	78.5	78.6	62.8	76.6	75.4
243	80.6	82.6	64.4	78.2	80.2
244	82.7	84.6	66.0	80.8	85.0
245	84.4	87.1	66.0	82.8	85.0
246	86.1	89.6	66.0	83.4	85.0
247	88.0	90.6	66.0	85.2	85.0
248	89.9	91.6	66.0	86.4	85.0
249	91.5	93.6	66.0	86.9	85.0
250	93.0	95.6	66.0	87.4	85.0
251	93.0	95.6	68.1	88.7	85.0
252	94.0	95.6	70.1	89.9	85.0
253	94.9	95.6	70.1	90.5	85.0
254	94.9	95.9	70.1	91.0	85.0
255	95.7	96.1	70.1	91.0	85.0
256	96.5	96.1	70.1	92.2	85.0
257	96.5	96.1	70.1	93.4	89.3
258	97.2	96.1	70.1	93.4	93.7
259	98.0	96.1	85.0	93.4	93.7
260	98.0	96.1	85.0	94.1	93.7
261	98.0	96.1	85.0	94.8	93.7

262	98.0	96.1	85.0	94.8	93.7
263	98.4	96.1	85.0	94.8	93.7
264	98.9	96.1	85.0	94.8	93.7
265	98.9	96.1	85.0	94.8	93.7
266	98.9	96.1	85.0	96.1	93.7
267	98.9	96.1	85.0	97.3	93.7
268	99.3	96.1	85.0	97.3	93.7
269	99.8	96.1	85.0	97.3	93.7
270	99.9	98.1	85.0	98.7	96.8

Appendix H

Phi Coefficients for Web Design, Presentation, and Spreadsheet Modules

	Half as many items as current Length	Current Length	50% more items than current Length
Web Design			
1 rater	.83	.89	.91
2 raters	.86	**.91**	.93
3 raters	.86	.92	.94
Presentation			
1 rater	.75	.83	.87
2 raters	.78	**.86**	.90
3 raters	.79	.87	.90
Spreadsheet			
1 rater	.78	.86	.89
2 raters	.81	**.88**	.91
3 raters	.82	.89	.92

Appendix I

Initial Contact Letter to Administrators

Dear :

My name is Jill M. Friestad and I am currently working on my dissertation at Drake University under the supervision of Dr. Janet McMahill, Associate Dean of the School of Education. Your school district was chosen at random from other AEA 11 schools to survey for this study. I am writing to request access, and permission, to administer the Tek.Xam assessment evaluation to 30 high school seniors as part of my doctoral study at Drake University in Des Moines, Iowa.

My study is intended to determine if high school seniors have the computer skills necessary in today's workplace (according to standards and benchmarks set forth by various agencies). The results will support the importance of including computer skills as a graduation requirement in the state of Iowa—an idea many other states, as well as the national government, currently supports.

More specifically, I want to determine the level of basic computer literacy and word processing skill seniors possess. To do this, I need access to a computer lab and 30 senior students for approximately two hours on a day of your choosing.

The timeline for administering the test is Fall 2001 (by the start of the Winter Break—ideally the later part of November). I hope to collect and analyze data and complete my dissertation next Spring. A summary of my final work will be sent to you personally upon your request.

I have worked for the Des Moines Public School District as a technology teacher for nine years and am presently teaching at Hamilton College. I understand some technical issues will need to be resolved regarding platforms, software, testing situations, and evaluation of results, but I am confident we can solve those issues together.

I appreciate your help with and attention to this matter. If you have any questions, clarifications, or concerns, please do not hesitate to call Dr. Jan McMahill or me (addresses enclosed). Thank you for your consideration. I look forward to working with you.

Sincerely,

Jill M. Friestad
Drake University Doctoral Student

Enclosure

CC: Dr. Jan McMahill

Appendix J

Administrator Demographic Sheet

1. Which of the following best describes your school setting?

_______Large (more than 4001) ______Medium (1001-4000)
_______Small (1000 or less) ______Non-public

3. How much money is budgeted for technology:

____________in your district? ____________in your building?

3. What type and brand of *software* is standard in your building?

4. Is a computer or technology course part of your district's graduation requirements?
_____Yes _____No

If yes, which one(s)? (Check all that apply)

____Basic Keyboarding
____Computer Applications
____Word Processing
____Spreadsheets
____Databases
____Programming
____Web Page Design
____Computer Aided Graphics
____Desktop Publishing
____Multimedia
____Networking
____Other __________________

5. How many computers do you have available *for student use* in the building? _______

6. What is the student:computer ratio in your building? __________________

7. Are all of the computers in your building connected to the Internet?

______ Yes _______ No (If no, how many are connected? ________)

8. Does your building or district have a plan for *integrating technology across the curriculum*?

______ Yes ______ No

9. On a scale from 1-5 (5 being the highest), how would you rate the comfort level of your staff in the following areas:

Basic Keyboarding _____
Word Processing _____
Spreadsheets _____
Databases _______
E-mail _______
Internet Navigation _______

10. Check all of the following options you believe are provided as technology support for your building:

_____ Staff Development from the district
_____ Building Technology Coordinator
_____ Teachers working with teachers
_____ Nearby colleges or universities
_____ Area Educational Agency (AEA)
_____ Workshops or seminars put on by independent agencies
_____ Videos
_____ Individual learning based on need or desire
_____ Other ____